FIRST BIENNIAL REPORT

OF THE

rnia State Board of Forestry,

FOR

THE YEARS 1885-86,

GOVERNOR GEORGE STONEMAN.

.CCORDANCE WITH THE PROVISIONS OF SECTION FIVE OF AN
CREATE A STATE BOARD OF FORESTRY, AND TO PROVIDE
THE EXPENSES THEREOF," APPROVED MARCH 3, 1885.

SACRAMENTO:
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REPORT

OF THE

CALIFORNIA STATE BOARD OF FORESTRY.

To his Excellency GEORGE STONEMAN, *Governor of California:*

The State Board of Forestry has the honor to present its first biennial report showing the progress and condition of our work. The separate reports of the Forestry Commissioners, of our efficient Secretary, of our Engineer, and of other gentlemen, will show what has been and what is being done in the line of our duty.

We have an Engineer now in the field ascertaining the condition of the forests throughout the State, the amount of damage done by waste and fire, and the effects of denudation upon the climate and watercourses. The partial report and forest map of our Engineer, Mr. Hubert Vischer, are herewith submitted. Mr. Luther Wagoner, Mining Engineer, has traced the present line of saw timber in Amador, Calaveras, Tuolumne, and Mariposa Counties, and reported on these counties to the Board, his report being annexed. Dr. A. Kellogg, of the Board, has prepared a valuable partial list of the trees and shrubs of the State. Mr. Abbot Kinney sends a report accompanying the forest maps of Los Angeles, San Bernardino, and San Diego Counties. He calls attention to the serious results of forest fires and forest denudation that have recently taken place in Southern California. It is of the greatest importance that the people, as represented by their legislators, should understand that the prosperity and tax-paying power of a large portion of California can only be maintained by a preservation of the mountain watersheds.

Civilization throughout the world has recognized this fact, and provided forest departments principally to preserve the climate and watersheds of their lands. Other important functions have been added, such as providing a permanent supply of lumber, fuel, tanning bark, etc.

We have found much sympathy and support throughout the State from private individuals.

The forest maps of San Diego and San Bernardino we owe to the volunteer work of Mr. John E. Jackson. The map of San Diego County is the volunteer work of Mr. T. S. Van Dyke and Mr. M. G. Wheeler. The very valuable report on the forests of San Diego County, by Mr. C. R. Orcutt, is also a volunteer work, contributed without any charge. We take this opportunity of thanking these gentlemen for their generous public spirit.

A movement has also been inaugurated in San Francisco for the setting apart of a day for tree-planting in California. This movement is headed by such influential citizens as Joaquin Miller, Adolph Sutro, Gen. O. O. Howard, and others equally prominent. We are heartily in favor of the movement, and hope that these gentlemen will continue their good work.

Our Board has distributed notices, against setting fires, through many portions of the State. The notice sets forth the penalty of violation of the

law in this regard, and has done much good. We are glad to report that the fires, especially through the mountains in Southern California, have been fewer and less destructive than usual.

At our instigation, special agents of the Land Office have examined into numerous cases of violation of the law, through setting fires in the forests and the unauthorized cutting of timber on the public domain. We hope to accomplish much good in this way.

The following is a copy of the circular letter sent out through the State, designed to create a greater interest in forestry, and impress upon the minds of the people the vital importance of the subject. It is believed to have well served its purpose:

OFFICE OF STATE BOARD OF FORESTRY, ROOM NO. 42,
NEVADA BLOCK, SAN FRANCISCO, CAL.

To the Citizens of California, and especially to the Farmers and Irrigators:

We earnestly call your attention to the following statement of your interests:

The forests of California are confined principally to mountain lands. These mountain forest lands are for the most part so steep and rocky as to be forever unprofitable in agriculture.

Their use, then, is and must be, the production of timber and fuel.

The climate of California, unique in its charms, has as its chief peculiarity a dry and a wet season. The forests of the State cause the rainfall to come more evenly and regularly than would be the case were the forests destroyed. They oppose impediments to the rapid flow of surface water, and thus mitigate floods and allow the rainfall to seep into the soil and veins of rock, to appear again as springs and streams in which water is provided for the long dry season.

Forests also modify and lessen violent winds and extremes of temperature, and of humidity.

It is, therefore, of interest to the citizens of California, that our forests should be maintained as to their reproductive power in timber and fuel, and it is of vital interest to the farmers and irrigators that the integrity and life of the springs and streams should be protected.

Wasteful and destructive methods of cutting the timber now prevail, and no regard is paid to the reproductive power of the forests.

Great and increasing damage is done every year by fire.

The present land laws of the United States are so ill-suited to the timber interest as to invite frauds. These frauds have grown to be the disgrace and reproach of the Government land system. In the forests of California the Government has a property of great value, not only directly, but indirectly, through the need of the forests and streams to maintain the tax-paying capacity of the people.

For this great property the Government has no care. No watch is set to prevent the depredations; no thought is taken nor action had to keep up its usefulness. The State school lands in forest, Sections 16 and 36 in every township, have also been most sadly neglected, and the school property wasted and destroyed.

For these reasons, the California State Board of Forestry believe that the Congress and Government of the United States should withdraw all the Government timber lands in the State of California from sale or entry.

To maintain such of these lands permanently in forest as shall be deemed necessary for the welfare of the State, and to guarantee the verdure on the watersheds so as to preserve the springs and streams, and to prevent the creation of destructive torrents injurious to the farm and valley lands.

Such forest reservation should be guarded from fire and depredation. The cutting of timber and fuel should be regulated in such a reasonable way as will preserve the reproductive capacity of the forests, and neither endanger the climate nor the springs and streams.

The expense of such care to be derived from a charge on the cutters of timber and fuel.

We also ask the aid of all citizens in preserving the State school lands in forest from timber thieves and fires.

The climatic conditions of California are so different from those of the other States, its forest area is so peculiarly limited to its non-arable lands, and its agriculture is so largely dependent on the maintenance of the water supply, that more than ordinary importance must be attached to the preservation of the forest and brush lands of the State. We therefore most earnestly ask the citizens of California to furnish us with any and all information they may have relating to this subject, and to aid us in bringing to judgment the depredators and wasters of the people's property.

The importance of the lumber industry is fully recognized. We have no idea, in any of our work or recommendations, to hamper this industry. But we believe that the land laws under which the lumbermen work are

so cumbersome and inappropriate as to invite fraud, and to injure those honestly endeavoring to obey them. In our opinion no more sales should be made of Government or State timber land not fit for agriculture. Such lands should be permanently reserved from sale and the control of the cutting of the timber placed in the hands of national or State forestry officers. The cost of license to cut timber should at least cover the cost of the supervision and care of the forests by its guardians. In this way the timber and fuel supply can be maintained without the injury and destruction of the forest that now attends these necessary industries. At the same time all improper denudation of watersheds whereby streams or springs are dried up, or destructive torrents formed, will be prevented. The people need have no fear that a properly organized forestry department will prove expensive. In every country where such departments exist a net revenue is turned by them into the public treasury. We do not expect our organization to be made complete and self-sustaining at once, but we desire to have our hands strengthened in some directions as soon as possible.

In this connection it will not be out of place to reproduce a petition which has been circulated and extensively signed by many of the most influential residents of the southern part of the State. It is as follows:

A Petition to the State Board of Forest Commissioners,

To prevent parties and persons from securing mountainous government lands, in the County of Los Angeles and State of California, for the purpose of cutting and removing the timber thereon.

To Abbot Kinney, *Esq., Member of the Board of Forest Commissioners, State of California:*

Whereas, It has come to the knowledge of the undersigned, that mountainous government lands in this vicinity are being appropriated by several parties; and believing it to be their intention to remove the trees and timber thereon, we, the undersigned irrigators in the San Gabriel Valley, respectfully call your attention to this fact. We believe that it will seriously interfere with and destroy the springs and watercourses in said mountains, the waters of which are used to irrigate the plains and valleys below.

Therefore, we respectfully petition you to use what influence and authority you can to stop the devastation of said forests, to the detriment and great injury of the irrigators and land below. This petition does not propose to interfere with parties taking up lands for other purposes than above set forth. We would also suggest that appropriate signs, with penalties attached, calling attention to the necessity of the careful use of fires in the mountains, be put in conspicuous places on all roads and trails.

The present fires that desolate the forests of California are a violation of law and are exceedingly destructive to public property. After continued earnest effort, in many cases with legal advice at our own private expense, we are obliged to report that we cannot arrest nor convict these fire-setters without the assistance of special officers, who can be sent into the mountains to secure evidence and find the depredators.

We herewith hand in several bills, the passage of which will enable us to encourage tree planting, and will assist us in protecting existing forests, at least from waste and useless destruction. We will also be able to complete the valuable forestry map and report now in progress, and provide forest guards.

Our Board has been in correspondence with the forest departments of other nations. By this means we have been able to furnish individuals throughout the State, desiring to plant trees, with useful information and the results of others' experiments. We desire to call attention in this connection, to the value of the *Acacia decurrens*, or black wattle, and, for very dry lands, of the *A. pycnantha*, or broad-leafed wattle, as producers of tannin. The results of a plantation of one hundred acres in South Australia of the *Acacia decurrens*, for tannin alone, at the end of seven years was $5,540 clear profit. The seed pods of this plant when green, and even after they are dry,

form an excellent substitute for soap—among the population here where the tree is known, these pods are considered the best material for washing all woolen goods. The stripped trees would here be valuable as firewood, and add to the profit. This tree reproduces itself naturally in California, and grows readily and quickly on poor lands almost everywhere in this State. It is, however, subject to scale pests where these exist. Our native sumacs contain considerable tannin. We are having them analyzed to find if the tannin is in sufficient quantity to justify the planting of these shrubs for profit. Considerable quantities of sumac tannin are imported into this country from Italy, which can doubtless be supplanted by a home-grown product, taken either from the native sumac or from those of Italy, which are equally well suited to our climate.

The most rapid grower and the tree giving the promptest return, when planted in favorable locations, is the *Eucalyptus globulus*, or Tasmanian blue gum. This tree is a native of Tasmania, which has a comparatively moist climate, with a rainfall of about twenty-five inches. This tree, therefore, does well where the air is moist, as upon the coast hills, or upon lands in the interior where the water is not too far from the surface. Like all the Australian trees, it will not stand long continued low temperature. It has proved a profitable tree as a fuel producer in the southern part of the San Joaquin Valley and in all the southern counties of the State, and it has done well wherever planted near the coast. It has been utilized thus far almost exclusively for fuel. Extensive plantations by Mr. Remi Nadeau and the Messrs. Beaudry, of Los Angeles, and Mr. Ellwood Cooper, of Santa Barbara, have proved very satisfactory. This tree, however, has its limitations, and does not do well in dry soils removed from the moist influence of the sea. Experiments made by the Chairman of the Board, on sandy lands at the foot of the Sierra Madre Range, in Los Angeles County, show this tree to be practically worthless in such locations. Extensive experiments in South Australia show that where the Tasmania blue gum fails, owing to excessive dryness, other and better trees, although of not so rapid growth, succeed well.

Trees that we are able to recommend for dry situations are: *E. corynocalyx*, or sugar gum; *E. leucoxylon*, or Australian blue gum; the *E. calophylla*, or red gum of West Australia; *E. rostrata*, or red gum of South Australia; the *E. siderophloia*, or red iron bark of New South Wales. The first two of these are probably the best.

The *Pinus pinea*, or stone pine, seems to be the coniferous tree best suited to dry locations of small elevation. *Pinus insignis* and *P. pinaster* also do well. *Catalpa speciosa* is a valuable timber tree, which will grow well in situations suited to the *E. globulus*.

The American white ash, the black walnut, and the black locust are valuable timber trees which have done well, singly and in small groves, in various parts of the State; but we have not sufficient data to recommend large plantations of them. Experiments by Professor E. Hilgard, at Berkeley, and plantations in Australia, show that the English oak (*Quercus pedunculata*) is a more rapid grower than our native oaks, and is therefore suitable to mix in tree plantations. Our own tanbark oak, which is very valuable, does well in damp situations near the coast. We would like to suggest here, to persons growing trees for tanbark, that experiments in Ceylon, in India, with the cinchona tree, show the advantage of not stripping the entire bark and killing the tree at once. Formerly this was the universal custom in cinchona plantations; now only portions of the bark are taken, the tree remaining alive and producing continuous crops, to the great profit of the planters. Another point that we desire to call attention to is,

that the experience of all the Forest Departments with which we are familiar, show that mixed plantations of trees do much better, as a rule, than plantations of one variety only. Certain trees grow better together than others, which makes the subject one requiring considerable scientific study. There should be several experimental stations, situated in the different climatic belts in the State, where the growing qualities of trees in our various climates can be tested. The University at Berkeley has thus far done an excellent work in this respect for that locality.

We have lands offered to us in several parts of the State, if we had funds to utilize them.

Much of the school land granted by the Government to the State for school purposes is in timber. A large portion of this land is of such a character as to be worthless for anything except timber. Reports from special agents of the United States Land Office show that considerable amounts of the school lands have been stripped of their timber, in violation of the law. Our attorney is now prosecuting one such case in the central part of the State.

We believe that the school lands in forest can be made a perpetual source of income for the schools and the forests still maintained on them. We therefore recommend that no further sales of these lands be made until the Engineer of the Board shall have reported upon their character; and such of these lands as shall be found to be useless for agriculture shall be permanently reserved and placed under the hands of proper officers for the benefit of the schools.

We are glad to be able to report that our Board is in perfect accord with the Forest Division at Washington, and with the resolutions adopted by the National Forestry Congress at Denver, in regard to the reservation from sale of all government forest lands not suitable for agriculture. As we have before said, the land laws governing the disposition of government timber lands are far from satisfactory and ought to be changed, if not as we suggest, in some other way. Much of this land is taken up, stripped of its timber, and abandoned. All such lands escheating to the State should, in our opinion, be placed under the control of proper officers.

One of the difficulties that forestry has to contend with in widening its sphere of usefulness is the scarcity of men acquainted with its practical details. At the suggestion of this Board, the University of Southern California at Los Angeles has inaugurated a School of Forestry, where forestry will be taught, and this want, at least, partially supplied. If this school is carried on as it has been planned, it will be of great value, and will be the only complete forestry school in the United States. We hope that the University of California at Berkeley will advance the great interest of forestry in the same way.

Part of our work should be the sending out of bulletins, from time to time, both for the purpose of giving information and of educating the people in forestry, so that they will know how to utilize forest lands owned by them to the best advantage. We also desire to make more complete collections of seeds of the native growths. These have been too much neglected in our State. In California grow some of the most valuable timber trees of the world.

The seeds of our trees are in considerable demand in foreign countries. For those that we send abroad we obtain in exchange the seeds of valuable growths of other countries.

In looking over the reports of the Engineers and Secretary of the Board, and of the volunteers who have contributed so much to make our report valuable and interesting, several points of general interest claim attention.

The redwood region is sketched out by our Engineer. He shows what is going on in that district, how the land laws work, and the immense importance of this lumber to California. This is undoubtedly the most valuable block of timber now standing in the world.

The present cutting of timber in California is no fair measure of what it is likely to be. The forests of the Eastern States and the great pineries of Michigan and Wisconsin are rapidly becoming exhausted. On the other hand the demand for lumber is as rapidly increasing.

The eyes of the lumbermen of the East are turning toward California for their next field of operations. We are credibly informed of several large eastern and foreign corporations who intend to exploit our forests. Now is the time to inaugurate a system by which the lumber industry may be carried on without the present temptations to violate law, and without injury to the climate and to the great farming interests of the State. The destruction in the forests caused by injudicious pasturage is very great. Complaint on this score is general in all mountainous parts of the State. Pasture exists in the mountains and among the forests. Under the European forestry system, similar pastures are used to their fullest extent. This we believe should be the case here also, but the present unregulated and irresponsible methods are bad, not only for the forests but for those utilizing the pastures.

No fact is better established than that improper pasturage, especially by sheep, kills out the useful fodder plants and all young growths of trees. The ground is unduly packed, floods become common and disastrous, and the soil in the end is washed from the mountains, thus making them worthless for all purposes. The example of Provence and Spain, where the merino sheep originated, show that the careless cutting of trees, the burning of the upper hills to improve pasture, and their overstocking with sheep, completely destroyed the entire mountain pastures of those countries. The secondary results were a desiccation and desolation of the agricultural lands, and a progressive diminution of the taxpaying power of the communities. In Provence these unfortunate events went on, accompanied by a decreasing population, whilst the rest of France was prosperously advancing in both these respects. We therefore think measures should be gradually introduced which should regard the large interests at stake with a view to improving the methods of utilizing our mountain pastures.

The State Board of Forestry of California desires it to be clearly understood, that they do not wish to interfere with or unduly vex any of the industries of the State connected with forestry. On the contrary, we believe that these interests can be best maintained and protected by proper and reasonable forestry regulations.

It is clear, from the reports referred to, that the interests of this State as to forestry are very different in its varying climatic and topographical belts. In the northern portions we find the forest covering a larger proportion of land than is considered necessary for the best interests of agriculture and climate. In this region we also find the forests strong in their power of self-perpetuation. So that the duties of a forester would largely consist in protecting and thinning out the new growths so as to make them commercially valuable. This is not generally the case in the new growths now; these come up too thick to promise a future value. As we go south, however, the air becomes drier, the rainfall less, the value of the springs and streams becomes greater, and the forests upon which these so largely depend, grow less and less, and their reproductive power grows weaker and weaker. In the south and east of the Sierras the trees once cut do not generally grow again. Fires in the brush, two or three times repeated, will leave their

bare scars on the mountains for years. As an illustration of this, the forest cut off on the east side of the Sierra, near Truckee, has left bare and rocky mountains in place of the former verdure. The stumps of the trees, cut by the Mission Fathers on the Sierra Madre, in the south, and the burnt remains of others, now stand in their chaparral without any prospect of new forest growth. It is from this cause that a fire which, in the extreme north, is considered a venial offense, is, in the south, deemed a crime against God and man.

In the north there is much land covered by forest that might with advantage be cleared and used for agriculture, but in the south the proportion of forest is far less than it should be. The larger part of this quarter of the State is absolute desert. The dry hot winds originating on these deserts would certainly destroy all vegetation upon the fertile lands, were it not for the forests and mountains that intervene. In the north the streams are not used to any extent for irrigation, but in the south the springs and streams are the life of the land.

The destruction of the forests in the southern counties means the destruction of the streams, and that means the destruction of the country. The State Board does not overlook these great differences, but hopes and intends to make its measures useful and satisfactory to all sections. To those who would like to inform themselves of the terrible results of forest denudation, we would suggest "The Earth as Modified by Human Action," by George P. Marsh, formerly United States Minister to Italy, and "Forests and Moisture," by John Croumbie Brown, LL.D., published in Edinburgh. These works are very interesting, and being the result of years of investigation, are well worthy of the study of the statesman.

Mr. Wagoner, in his report, alludes to the opinion of some old settlers, that the cutting of trees upon the immediate banks of some of the streams in the north either actually increased the flow of those below, or did not diminish it. This sometimes occurs, particularly in moist or cloudy countries where the direct evaporation caused by the sun is not great. The effect where produced is caused by the detention of the stream by tree roots, and the diffusion into the air by the leaves of the water taken up by the trees themselves. We mention this because an instance of this kind might confuse the opinions of those not understanding the phenomena. In mountains, the number of actual cubic feet of water delivered annually under the same rainfall from a watershed, is undoubtedly less when forested than when bare; but the advantage of the forest is, that it attracts the moisture and holds and detains the rainfall so that it flows off in a slow and gentle manner, either by the streams or by springs caused by the water's seeping through rock veins. But the bare watershed throws off all the rainfall at once in one great destructive flood, carrying before it rocks, gravel, soil, and everything; with these it ruins the valley lands below. Nothing illustrates these effects better than the fact that the heavy rains of the coast counties, falling upon forested mountains, run off in well defined channels, and seldom, if ever, cause destructive floods; whereas, the very light rainfall of the Colorado Desert, seldom over four inches per annum, and often not two, falling on perfectly bare mountains, covers the whole country with a sheet of rushing water, and washes away miles of railroad track at a time. We believe that there is nothing more important to the welfare of this commonwealth than the preservation of its splendid forests.

ABBOT KINNEY,
JAMES V. COLEMAN,
A. KELLOGG,
State Board of Forestry.

REPORT OF THE SECRETARY.

SAN FRANCISCO, CAL., November 1, 1886.
Room No. 42, Nevada Block.

To the State Board of Forestry:

I have the honor to submit the following report, made under the direction of the Forest Commissioners of California. It sets forth the origin and organization of the State Board of Forestry, and an account of that portion of its work coming most directly under my supervision. The Act "to create a State Board of Forestry and to provide for the expenses thereof," under which the present Commission is operating, was approved March 3, 1885, and is as follows:

The People of the State of California, represented in Senate and Assembly, do enact as follows:

SECTION 1. There shall be established a State Board of Forestry, consisting of three persons appointed by the Governor of the State.

SEC. 2. Each member shall hold office for the term of four years, and until his successor shall be qualified.

SEC. 3. The Board may appoint and prescribe the duties of its Secretary, and elect one of its own members Treasurer, both to hold office at the pleasure of the Board.

SEC. 4. The duty of the Board shall be to collect statistics and other information with regard to forestry, tree culture, and tree preservation, throughout the State; to correspond with various forestry societies and individuals, for the purpose of obtaining such information; to learn by investigation and experiments the adaptability of various trees to the different sections of the State; to disseminate such information throughout the State in such a manner as to aid and encourage the purpose for which this Board is formed; to assist in enforcing and carrying out all national and State forestry laws, as far as practicable; to act with a special view to the continuance of water sources that may be affected in any measure by the destruction of forests near such sources; to do any and all things within their power to encourage the preservation and planting of forests, and the consequent maintenance of the water sources of the State.

SEC. 5. This Board shall report biennially to the Governor a detailed statement of its work, which shall include all disbursements that may have been made. All printing required to be done by the Board for their official use shall be done by the Superintendent of State Printing.

SEC. 6. There is hereby appropriated for the use of this Board, out of any moneys in the State Treasury not otherwise appropriated, the sum of five thousand ($5,000) dollars for the two years beginning the first of April, eighteen hundred and eighty-five: said sum to be used for the payment of the salary of the Secretary, not to exceed the sum of one hundred and twenty-five dollars per month, the necessary traveling expenses of the members of this Board, the employment of assistants, and such other needful expenditures as this Board may incur, and the State Controller will draw his warrants on the State Treasurer in favor of the Treasurer of the Board for the same.

SEC. 7. The members of this Board shall receive no compensation.

SEC. 8. All Acts or parts of Acts in conflict with this Act are hereby repealed.

On the first day of April, 1885, the following named gentlemen whom his Excellency the Governor had been pleased to appoint Commissioners, under the Act, viz.: Honorable James V. Coleman, Chas. M. Chase, and Dr. A. Kellogg, met at the rooms of the Academy of Sciences, in San Francisco, and proceeded to organize the California State Board of Forestry. Mr. Coleman was elected Chairman, Mr. Chase, Treasurer, and Sands W. Forman, Secretary. In the month of May, 1886, Mr. Chase resigned as a member of the Board, and the vacancy was filled by the appointment of Honorable Abbot Kinney, of Los Angeles. The Board then reorganized by the

election of Mr. Kinney as Chairman, vice Mr. Coleman, resigned, Dr. Kellogg, as Treasurer, the office of Secretary remaining as before.

The first work of the Commission, after this reorganization, was the sending out of circulars asking information concerning the condition of forest and timber lands throughout the State, the quantity and quality of wood cut or left standing, its commercial and domestic uses and value, and requesting suggestions for the encouragement of tree planting, and the prevention of forest fires. It is to be explained that, although these circulars were sent to the County Clerk of every county in the State, and to private individuals, who, it was thought, would interest themselves in the subject, answers were received to barely one fourth of them. This, perhaps, may be attributed to the fact that the questions put, in order to be properly answered, required investigation and research, which few had time to give, and it may have been that to those living in the midst of great primeval forests, where the axe of the woodman and the surge of devastating flames have not yet done irremediable damage, the importance of replying to our inquiries did not sufficiently commend itself. Or we may, perhaps, attribute their silence to this: that even now, too many consider the timber resources of our great State well nigh inexhaustible, or at least a subject that need only vex the minds of generations yet to come. The direful effects of the denudation of vast timber tracts which have made their appearance in older States, are comparative strangers to the people of the Pacific Slope, but so surely as the decline of countries and peoples, both modern and ancient, may, in many cases, be laid to this cause (and instances are too frequent and self-convincing for contradiction), so surely will this great commonwealth in time be made to feel these same effects, if some means be not taken to check the useless and too often reckless felling of our forests.

Although, as has been said, Forestry is to our people a comparatively new subject, yet the baneful results of injudiciously denuding the bosom of mother earth have most cruelly forced themselves upon mankind for ages past, and led to the framing of restrictive laws, and laws for the encouragement of tree planting, which we may study to our profit. The highest officers in the land were often made the custodians of the forests, and in the far away Empire of Japan a law has been in existence from the earliest times providing that where a tree has been cut down, another was to be planted in its place. The ancient Germans had also a law which provided that all trees to be felled should be marked by a competent forester, and the unlawful felling of a tree was often punished with death. But notwithstanding these safeguards, man's selfishness, recklessness, and ignorance combined to destroy and ruin vast tracts of wooded land which should have been left as a heritage for future generations. Republics are prone to live for the day, and let the coming man look out for himself. Our own is no exception to this rule, and it would seem that we dwellers on the Pacific Slope are, perhaps, more reckless than others in this respect. The State Board of Forestry, however, does not need to call the attention of those now living, to the claims of generations to come, in order to explain the importance of tree preservation and culture. The men and women of to-day are vitally concerned in this subject, and it will require but a few speeding years, at the rate at which our timber lands are being denuded, to bring home to our doors the same disastrous results which have made desolate and sterile lands that were once as fertile as our own.

It is hardly necessary to refer to the many notable instances of wreck and ruin that have resulted from the indiscriminate and injudicious felling of forests. Countries that were once densely populated, fertile and pros-

perous, are to-day but thinly settled, sterile and bleak, the result of the improvidence and ignorance of man. Look at the state of the countries of western Asia, northern Africa, and southern Europe as compared with their condition in days gone by when their peoples ruled the world and the products of their soil found ready market in every port where their argosies sought anchorage. It is more than lamentable to compare the present physical condition of these countries with the accounts given by historians of their former greatness, their fields of cereals that waved their golden treasures in every nodding breeze, their glorious agriculture that was their pride and the envy of their neighbors. All this has been long a thing of the past. The cumulation of ages of toil has been given over to desolation, and great tracts that once bloomed and blossomed are now devoid of commerce, art, or agriculture. Their great life-giving forests are no more; the virgin earth has been swept away, and the once fruitful meadows that gave occupation and food to a thrifty, if reckless people, are now but a waste, because the water supply that once had nourished them has vanished with the trees that stood upon the watersheds of the running streams.

It is not proposed to go here into explanation of the effects which the forests have upon the springs and water sources; their timely holding of the snows upon the mountain tops and sides; their ameliorating influence upon climate; their thousand and one benefits that the animal and vegetable kingdom must be thankful for. All these have been already so well set forth, so conclusively proven by the greatest scientists of the day, so often and so clearly brought to the attention of the reading public, that the task of repetition would be as thankless as unneeded. It will not be necessary to recall in detail the laws that other nations have passed restrictive and otherwise, for it must be conceded that those which now prevail throughout the different States are modeled for the most part after them, but it will not be out of place to summarize those that our sister States have adopted, that we may see how far their needs are like to ours, and profit by their experience in what our own laws may be lacking. Space forbids the giving of more than the prominent points in the forestry laws that find place in their statute books.

WHAT THE STATES HAVE DONE.

California—For willfully setting fire to any wooded country or forest belonging to the State or Federal Government, or to any place where fire would communicate to such forests, a penalty of not more than $1,000, or a term of imprisonment, not more than one year, is imposed. A Forestry Commission was appointed in 1885—whose objects and duties are defined in the Act printed in another place.

Colorado—Provides that the General Assembly shall enact laws in order to prevent the destruction of, and keeping in good preservation, the forests upon the lands of the State or government, the control of which shall be conferred upon the State by Congress. A Forest Commissioner is appointed who has the care of all public wood lands, to prevent trespass, the starting of fires, and to see to the conservation of forest growth. The County Commissioners are enjoined to encourage the planting of trees along watercourses and ditches. Persons are made liable, in triple damages, for injuries to trees, and the increased value of land from tree planting is not to be assessed for a period of ten years from planting; a premium is also offered for six consecutive years, for every one hundred forest trees planted along irrigating ditches.

Connecticut—In 1877, a law was passed to encourage tree planting, which provides that planted wood lands, which at the time of planting were not worth more than $15 per acre, shall be exempt from taxation for a period of ten years. By an Act of 1881, a bounty was offered for planting trees along the highway.

Dakota—Parties planting trees along public highways may occupy and use one rod in width of such highways for the purpose of cultivating the growth of timber and trees thereon.

Illinois—Counties are allowed to offer as bounty, to persons planting forest trees and caring for them three years, any sum not exceeding $10 per annum for three years, for each acre so planted.

Iowa—Passed an Act in 1868, exempting from taxation the real and personal property of each taxpayer, who should plant and cultivate one or more acres of forest trees for timber, to the amount of $100 for ten years, for each acre so planted and cultivated.

Kansas—In 1868 had a law giving a bounty of $2 per acre for planting any kind of forest trees, except black locust, to continue for twenty-five years. This was amended in 1872, requiring at least one hundred and sixty trees to the acre. Two years later this Act was repealed, and one enacted providing penalties for kindling fires upon lands not owned and occupied, leaving the same unextinguished.

Maine—Exempts from taxation, for twenty years, lands from which the primitive forests have been removed, that are reset to trees.

Minnesota—An annual bounty of $2 per acre, and a like annual bounty for every half mile of trees along the public highway, to be paid out of the State Treasury.

Missouri—A similar law exists, except that the bounty is paid by the county in which the trees are planted.

Nebraska—An exemption of $100 per year, for five years, on each acre planted, and a further provision that the increased value of land by reason of live fences, fruit and forest trees grown thereon, shall not be taken into account in the assessment thereof.

Massachusetts—Provides that the agricultural societies shall offer premiums at their discretion for the raising and preserving of oaks and other trees best adapted to perpetuate a supply of ship timber. Also encourages the formation of societies for the purpose of improving streets and public squares, by planting ornamental trees thereon. In 1882, the State passed an Act authorizing towns and cities to provide for the preservation and reproduction of forests.

New Hampshire—Passed an Act in 1881, appointing a State Board of Forestry, to inquire as to the destruction of forests, the effect of forests on rainfall, and the condition of streams, and in regard to the wisdom or necessity for forestry laws. Towns are also empowered to raise money to set out shade trees and abate taxes to persons who do so.

Nevada—An annual bounty of $10 per acre and $10 per half mile, along public highways, for twenty years, paid by the county, and such planting not to add to or increase the taxable value of said land. The Act does not apply to willows or cottonwoods planted along canals for the protection of the banks.

New York—Allows overseers of highways to give a rebate of $1 for every four trees set out along the highways; has also appointed a Forest Commission, to which are given extensive powers of control over all the public lands of the State. Provision is made for introducing forestry into the schools, and for publishing tracts and circulars on trees and tree planting. Effective laws have also been passed for the protection of forests from fire.

Ohio—Passed an Act in 1882, establishing an Agricultural Experimental Station. Part of the operations are to be the planting and testing of trees in an arboretum, and the encouragement of tree planting throughout the State. Later a Forestry Bureau was established in connection with the State University at Columbus. This bureau is now engaged in establishing forestry experimental stations.

Vermont—In 1882 appointed Commissioner "to inquire into the subject of the forests of Vermont, as to their extent and condition, and as to what, if any, measures should be taken in respect to their preservation." The report of the Commission made many recommendations for the better protection of forests, which will ultimately be made legal enactments.

Wisconsin—Exempts from taxation lands set to belts of trees until they attain a height of twelve feet; afterward the owner of such tree belts is entitled to an annual bounty of $2 per acre. These tree belts, it is provided shall be on the west and south side of tracts of land, and not less than thirty feet wide for each five acres of land.

COUNTY REPORTS.

The following is a copy of "Inquiries" prepared by the State Board of Forestry and forwarded to every county in the State, and although answers were received, as has been stated, to barely one fourth of them, yet from the fact that the northernmost and southernmost, as well as many of the intermediate districts, have been heard from, the results may be considered partially satisfactory and the information gained worthy of publication. Some replies, it is true, were returned, which possessed little or no value, and these have been omitted.

INQUIRIES.

No. 1. State to what extent the native forests in your county have been cut off, and what kind of timber is left standing, and to what uses it is adapted?

No. 2. State for what purposes the forests have been cut, whether for lumber, fuel, or other uses, or simply to clear land for agricultural purposes?

No. 3. State the estimated amount of young wood growing up, and how far it will supply the place of that removed?

No. 4. State what would be the advantage in your opinion of planting trees in your county, and what trees would be best adapted?

No. 5. State what amount in acres (approximate) of the native forests has been destroyed by fire, and what means should be taken to prevent destruction of timber by fire in the future?

No. 6. State what, if any change, in character of climate, amount of rainfall, and volume of water in streams has been noted since the acreage of wood land has decreased?

No. 7. State whether there has been or is any illegal cutting of timber in your county; and if so, to what extent?

No. 8. State the proximate elevation that insures the best quality of timber, as well as dimensions; any remarkably developed tree or shrub in your locality, and the common or local name in addition to that given, and the purposes however unimportant for which they are employed?

No. 9. State what products other than wood are collected, such as tannin, charcoal, dyes, potash, edible fruits, forage, etc., and other uses in general or particular to which the forests are put?

ALPINE COUNTY.

Replies to Question No. 1.—One quarter of the forests has been cut off, for wood and lumber, and the timber left standing is black and yellow pine, and white and red fir.

No. 2.—For lumber and fuel, and mining purposes to some extent.

No. 3.—Wherever there has been a forest cut off, the young growth is starting up slowly, and it does not appear to grow very rapidly; does not exceed in growth two feet in height in a year.

No. 7.—I should judge that at least two thirds of government land had been illegally cut over.

No. 8.—Five thousand feet is the proximate elevation that insures the best lumber. Dimensions of the largest pine are from four to six feet in diameter, and from one hundred and fifty to two hundred feet in height. Firs grow fully as large.

No. 9.—None.

W. W. HARVEY, County Clerk.

EL DORADO COUNTY.

No. 1.—Fully 300,000,000 feet has been manufactured for building uses, besides immense quantities have been utilized for fuel, fence, posts, railroad ties, shakes, and mining purposes; perhaps, not over one tenth has been cut. There are many varieties of timber, the more valuable are sugar pine, yellow and punkin pine, spruce, fir, cedar, (and oak, which seems to be best adapted for fuel). I should judge that but a tenth of the forests available, have been cut.

No. 2.—The forests have been cut for uses named above, although considerable of the younger growth has been made into charcoal for local use—for such use there is an unlimited quantity. Few have the courage to hew out a farm in the thick timber, but commence on places partly cleared by sawmills.

No. 3.—The young timber springing up is far denser in growth than that removed; in fact it more than counterbalances the forests cut for all uses whatever. Some trees have already attained a diameter of two feet, and seventy or eighty feet in height, and at the present used to some extent for fuel, charcoal, and mining posts; even now some could be cut into bolts for box lumber.

No. 4.—I believe if we guard well the younger growth from the inroads of fire, and judiciously use the older growth, the supply must ever equal the demand, judging from present use.

No. 5.—Where the forests are in their primeval state, fire does but little damage, consuming mostly prostrate trunks and broken branches. On the other hand, it will, among the younger growth, completely destroy it, but fortunately such places are more thickly inhabited, and property holders find it to their interest to guard against fire as much as possible.

No. 6.—Some of the oldest settlers are of the opinion that the rainfall has increased.

No. 7.—In early days much timber was cut on government lands and left to waste, only the first cut or two being used. Since the land has been surveyed by government, mill owners and others have tried, in most cases, to obtain timber lands by lawful means.

No. 8.—From three thousand to five thousand feet; the products of the forest are the most valuable; the average diameter is, say thirty inches for milling purposes, although many trees will scale from five to eight feet in diameter, and some I have examined that had a diameter of ten feet.

No. 9.—Considerable charcoal is made for local use; none has been shipped from the county to my knowledge. Some tanbark has been used from time to time, but for local use only. A good many of the forest trees, as well as some few varieties of brush, afford considerable forage all the year round for stock. The yew tree, growing in deep cañons, has lately been utilized for archery purposes; there is a few varieties of berries, but of little value; resin and other products of wood have not been manufactured but little as yet—this is a matter of future time.

BLAIR BROS., Millmen.

Data received from J. M. Anderson, Esq., U. S. Deputy Surveyor:

Pine timber belt commences about range 12 E. in T. 10 N. The timber for ranges 12 and 13 is pine—yellow and sugar—black oak—occasionally a white oak flat—some maple along streams, and also yew along the streams; some live oak. Spruce grows luxuriantly and does not reach much above the east boundary of 13 E., and then fir grows to great perfection. The principal timber of ranges 14 and 15 E. is yellow and sugar pine, fir, and some black oak. Ranges 13, 14, and 15 are heavily timbered; here the finest sugar pine grows. Ranges 16 and 17 still more yellow and sugar pine, but these timbers do not make as fine lumber or shakes (the pine described in these ranges is not so fine as that of 13, 14, and 15), and here the larch pine makes its appearance, or what is commonly called tamarac, and the timber becomes stunted.

About one fourth of the timber belt has been cut over, but that taken has been from that most accessible, and of fine quality. There is some brush in the timber belt, but not so much as lower down—principally manzanita, shingle brush, and what is called deer or buck brush. In the mountainous regions, in swampy places, also grow quaking asp, poplar, and some little cottonwood.

All over the timber belt, and throughout the county generally, where the timber is cut off or destroyed, and the land remains undisturbed, young pines, fir, spruce, and other timber common to the country springs up almost like magic, and grow very thick, as also in parts does the different varieties of brush. The fires do most damage to these young growths of timber. Fires arise from various causes—clearing of lands, carelessness of campers, stock herders, hunters, etc. It is thought that the damage to old timber high in the mountains, from fires, is not very great. The timber in the westerly part of the county fit for milling purposes has been pretty thoroughly cleaned off, and the lands given up to agriculture and stock raising, fruit trees, and vines. In this portion of the county, where not farmed or closely grazed, young pines and other timber have sprung up, often making dense thickets.

MONTEREY COUNTY.

No. 1.—To no considerable extent have the forests been cut off. The timber in the county consists of oak, pine, and redwood. The oak and pine is used for and is good for nothing but firewood, though some of the pine has been cut for lumber. There is a considerable quantity of redwood on the coast below Monterey, and but little has been cut as yet.

No. 2.—Answered above.

No. 3.—None growing except fruit, shade, and ornamental trees.

No. 4.—Salinas Valley for a distance of seventy-five miles is ten or twelve miles wide, and the soil as good as any in the world, but in the Summer and Fall there is a strong wind which amounts almost to a hurricane at times, blowing up the valley, withering all vegetation, except where trees have been planted, and protect the crops, from which I am satisfied that three or four rows of eucalyptus trees across the valley every half mile or mile would insure good crops.

No. 5.—No very considerable amount has been destroyed. Fire is generally started by hunters and campers. Know of no means to prevent fires.

No. 7.—Not any.

No. 8.—The highest elevations in Monterey County are between 3,000 and 4,000 feet above level of the sea. Don't think there is any difference at which elevation timber grows best. The redwood tree from three to six feet in diameter. I have seen one twenty feet in diameter, and several over ten feet. It is used for lumber.

No. 9.—The acorn from the oak is used for feed for hogs. Some tanbark is being cut, of which there is considerable on the coast from Monterey City to San Luis Obispo County.

M. L. DEXTER.

NAPA COUNTY.

No. 1.—In the western half of the county a large portion of the forest timber has been cut; in the eastern half, very little. Principally pine, fir, and the several oaks indigenous to Napa County, with a limited amount of madrona, laurel, alder, ash, etc.; principally for fuel; a small portion for manufacturing.

No. 2.—A small portion for lumber; mostly in clearing land; most of it has been sold for fuel or burnt into charcoal.

No. 3.—Only a very small portion of young wood is growing up, as all of the valley land is in cultivation, and most of the available mountain lands. The present supply of timber for purposes of fuel is abundant, and will continue so for some years yet.

No. 4.—Most of the land that could be used for forest culture will soon be required for viticultural and horticultural purposes. Australian gum, the most profitable tree to cultivate, as it grows well in stony soil.

No. 5.—Loss by fire has been very small, most of it the result of careless campers and hunters in the mountains. A law that would punish by fine and imprisonment would be most effective.

No. 6.—I think no perceptible change has resulted to either climate or amount of rainfall from removing forest trees, and most of the land has been planted to fruit trees and vines, thereby increasing the amount of leaf surface.

No. 7.—There has been very little illegal cutting of timber in Napa County, and that mostly by homestead claimants, but, after cutting off the timber, have abandoned their claims.

No. 8.—I do not feel competent to answer the first division of the above question. There is no remarkably developed trees or shrubs of which I have any knowledge.

No. 9.—Only a small amount of charcoal and tanbark; the forest is used in a general way for grazing purposes.

N. L. NIELSEN, County Clerk.

PLACER COUNTY.

No. 1.—In the foothill portion, one half to two thirds has been cut off. In the higher mountains, one quarter to one half, according as the ground is smooth enough for logging and wood team. In the foothills some oak and nut pine are left standing. It is used for fuel. The underbrush, manzanita, chaparral, etc., are grubbed out when clearing land, and the best used for fuel.

No. 2.—In early days yellow pine, fit for lumber, grew as low down as Auburn, altitude 1,375 feet; now the ridge between the American and Bear Rivers is practically denuded of large trees as far as Colfax, altitude 2,441. On the two "divides" there are some ten or twelve lumber mills, Towle Brothers having the largest. In the foothills about Auburn, in clearing the land for agricultural purposes, the largest timber is made into wood; some coal; balance burned up.

No. 3.—There is considerable live oak sprouts or saplings growing where old stumps stood; also, dense groves of young pines, which grow very rapidly when trimmed up, thinned out, and kept free from fires. Some so cared for are twelve to fifteen inches through; have seen smaller trees cut in parts of the East for the mill. With care, the new growth ought to supply our future fuel; but fires, and destructive husbandmen, I fear, will unnecessarily destroy it.

No. 4.—In some of the rocky high points there should be tree planting—yellow pine, oak, walnut, etc. In the meantime the bounty for tree planting along highways should be observed. Our Supervisors refuse to pay this bounty, although several applications have been made.

No. 5.—Impossible to give approximate acreage. One fire last year burned along American River Hill one mile wide by three in length. Another over two miles near Lincoln. Damage by last, say $10,000. Perhaps an inducement by rebate of taxes for strips of land around timber tracts, carefully grubbed, plowed, and kept free from grass. A better enforcement of Section 384, Political Code, and Statutes 1871-72, page 96, or by resorting to systems of rewards for informers.

No. 6.—Old settlers say the climate is more changeable than of old—colder in Winter and hotter in Summer. The water runs off very rapidly. This Winter has given us the heaviest rainfall for years. If the young timber could be protected it would soon give a dense foliage in the mountains. The forests around Lake Bigler should be preserved:

No. 7.—In years past, yes, but at present cannot say. I have been shown gigantic sugar pine trees, five feet in diameter, felled on Government land—may be on railroad land—by shake makers, which would not split freely, and would be left to rot. It is pretty late to "lock the stable door" now. Let the Government officers answer the question if they can; I cannot.

No. 8.—2,500 to 5,000 feet seems to be the best altitude for lumber producing trees, yet very fair lumber trees grew once near Auburn. Nature seems bound to cover the hills; thirty-five years ago the Indians kept all brush burned off; now it is thick on the ground. If you strip off oak, young pines seem to grow in their place. Cut off pine, manzanita takes its place. No peculiar shrub or tree in this locality. Considerable manzanita is cut for canes and other fancy wood work.

No. 9.—We have an iron mine and furnace six miles north of Auburn. They use vast quantities of charcoal. Common nut pine they say makes the best. Much mast, or acorns for hogs, falls from the oak trees. The subject of forestry is one the United States must meet inside of twenty years. I believe if a tree could be found fit for railroad ties, a rapid grower, the waste places could be planted to a profit. I am in favor of a State law like that of Nebraska—an arbor day. Get the people in the habit of planting, and not destroying. Enforce the bounty for planting trees—nut trees if possible—along highways. Exempt forever an acre of waste land carefully set out as a forest grove. Your Board should select a small tract, say an acre, for an experimental grove. Education and demonstration for the teachable. Strict laws for the vicious and unnecessary destruction of forests. The decadence of Spain, history says, commenced when the forests were stripped of their best timber to build the invincible armada. Some of the eastern States now are on the decline for the lack of timber in the right place—in the high hills and mountains. It is only a question of time when we become a second Peru.

SAM'L J. PULLEN, County Clerk.

SAN JOAQUIN COUNTY.

No. 1.—Live oak, white oak, water oak, and willows. These have been cut off a great deal, and along the rivers there still remains a great deal of timber only fit for fuel.

No. 2.—A great deal has been cut off to clear the land for agricultural purposes, and this has been used for fuel.

No. 3.—The young trees growing up do not amount to much in this county.

No. 4.—Planting trees in this county is not very extensive. Any kind of a tree, however, will do well here.

No. 5.—None.

No. 6.—Since the wood has been cut out along the rivers, the farmers have built large levees along the banks and kept the water within these banks.

No. 7.—None.

No. 8.—The gum (blue and iron bark) makes the best growth of any tree, and produces very fine fuel. Our county is very nearly level.

No. 9.—The raising of grain and vegetables where the forests are cut.

C. W. YOLLAND, County Clerk.

SANTA CRUZ COUNTY.

No. 1.—It is estimated that full forty per cent of the native redwood has been cut off, and also the following: pine, madrona, alder, willow, and oak—the latter for its bark for tanning purposes.

No. 2.—The redwood is cut almost entirely for manufacturing purposes, such as telegraph poles, shingles, shakes, posts, for fencing and railroad ties and fuel, and for charcoal for powder. After the land is denuded from the trees cut for the above purposes, the stumps are taken out also if possible and the land is then devoted to agriculture.

No. 3.—The native redwood never dies; from the stumps four to ten feet across spring suckers, which, if cared for by thinning out and trimming, will in twenty years produce trees two to four feet in diameter.

No. 4.—In all parts of the county where considered advantageous fruit trees of all kinds are being planted, but no forest trees; fruit trees are best adapted, forest trees being in abundance.

No. 5.—Fires are frequent during the Summer months, sometimes extending over thousands of acres, but do not destroy many of the trees, they being fed by the brush and underwood; trees are badly scorched at such times, but they sprout again and appear to grow more vigorously as does the brush—only by a very careful watching and following of hunters and campers to see that they leave no fires burning.

No. 6.—There has not been any change worthy of note during the last thirty years; if any change has taken place it is not perceptible.

No. 7.—Not that has been made public in any way.

No. 8.—Throughout the mountains the various kinds of timber appear to grow more vigorously, and quality is better upon the sides of the cañons more than upon the summits, which are two hundred to one thousand feet above sea level. There is a group of native redwoods, measuring—the largest—sixty feet in circumference, known as the Big Trees, at "Big Tree" Station, on South Pacific Coast Railroad, eight miles north of Santa Cruz—employed for show only.

No. 9.—The oak known as the tanbark oak tree is servicable for its bark, which is used for tanning purposes; the bark possessing a larger percentage of tannin than any other known. Charcoal made from madrona, alder, and willow is used by the powder works here for making explosives of various kinds; the other uses are for lumber, etc., and fuel.

VITALITY OF REDWOOD TREES.

The writer of this owns a piece of land about eight hundred feet above the sea level, in the Coast Range of Santa Cruz County. About three years ago many trees were felled, sawed into lengths of about fourteen feet, then rolled down and into a cañon near by. One year after, one of the frequent fires took place, and followed up the cañon, burning all the small stuff that was inflammable, and completely charring the outside of the logs mentioned, of which there was some twenty, about three and one half to four feet in diameter. Six months ago he saw the top log of all sprouting from its sides, with numbers of green sprouts upon which the leaves had formed. The log had been cut from the tree, and much burned afterwards by the intense heat and flames drawing upwards through a small cañon, and had been lying where seen sprouting about two years and a half, and it still lived, and is yet living, not touching the earth anywhere, but resting upon other logs beneath.

S. L. WILLIAMS.

SANTA BARBARA COUNTY.

No. 1.—The live oak (Quercus agrifolia) formerly covered an area of about twenty-five square miles in the valleys of Carpenteria, Montecito, Santa Barbara, La Patera, and Dos Pueblos, on the sea side of the Santa Inez Range, but most of the trees have disappeared. Perhaps one fifth of this area is still standing in small groves and along the roadsides. The mountain ravines are yet filled with a scattered growth of these trees, together with sycamore and other species. The white oak (Quercus lobata) is scattered over the interior valleys, and is still untouched to any extent; but the rapid settlement of these lands will soon make inroads upon the trees. A body of coniferous timber at the headwaters of the Sisquoc is said to contain from nine thousand to ten thousand trees fit for lumber, on an area three quarters of a mile long and half a mile wide. This is at present inaccessible, and of course is untouched. The cottonwood and willow is found in groves along the interior streams.

No. 2.—Most of the live oaks have been cut to clear the lands of the rich alluvial valleys above mentioned for agricultural purposes, and large quantities have been taken to the City of Santa Barbara and used for fuel.

No. 3.—The mountain sides, especially of the Santa Inez Range, are covered with chaparral, and many young live oaks are scattered through, but fires annually burn large areas of this young timber. The planting of belts of eucalyptus in the Santa Maria Valley, in its settlement, has added greatly to the forest areas; in fact, it was originally a bare plain. There are several groves and belts of this tree near Santa Barbara, Mr. Cooper having about two hundred thousand trees. The rich valleys from which the live oaks were taken are being rapidly covered with walnut and fruit orchards, fruit and nut raising being the dominant industry.

No. 4.—The valleys of the Santa Inez, Santa Maria, Sisquoc, and Los Alamos have high trade winds in the Summer, and all kinds of temperate climate fruits do well where protected from these winds. Monterey pine and cypress, the red and blue eucalyptus, and some species of acacias, all seem desirable for planting in belts. The latter is subject to insect pests, and consequently is in "bad odor." For timber and fuel the acacias and eucalyptus (some species) are the most desirable as quick growers. The black and silver wattle are rich in tannin.

No. 5.—The live oak forests have suffered but little from fires, yet the small trees on the mountain sides have been destroyed in that manner. Perhaps five thousand acres in the county would cover the loss by that cause. Stringent laws should be framed to prevent such fires. Hunters and campers should be made to feel severe penalties for carelessness. Fierce fires sweep over our mountains each year by such heedlessness. I would like to see a Commissioner appointed in each county to look after forest interests.

No. 6.—I apprehend that little climatic changes have occurred here, as the trees destroyed have been replaced by nearly the same number of trees in orchards and otherwise. I do not learn that the volume of streams has decreased. After a severe fire in the Santa Inez Mountains, at the head of Carpenteria Creek, I ventured a statement that the denudation of the watershed of that stream would increase the liability of floods, and during the following Winter a so called cloud-burst occurred, which destroyed much property and two lives, changing the course of the creek in some places. I have noticed that the winds sweep through the Carpenteria Valley with greater force, and that the frosts are more severe, since the live oak forests have been cut down. Without doubt forests modify winds and temperature.

No. 7.—From inquiries of our best surveyors and others, I cannot find that there has been much illegal cutting of timber.

No. 8.—The forest of pines, etc., before referred to, is at an elevation of four thousand feet. The largest examples of our live oak and sycamore are at an elevation little above tide water.

No. 9.—Few products have been extracted from our woods. A small amount of charcoal from the red alder has been burned for blacksmiths' purposes. The piñons from the nut pines growing on our higher mountains are used by the native Spanish population. The white oaks of the interior valleys have been cut down in excessively dry seasons for browsing fodder for the cattle, and that is one cause of the forest diminution.

F. L. KELLOGG, County Clerk.

SONOMA COUNTY.

No. 1—Cut off fifty per cent. The principal timber standing is: First, redwood, adapted to building purposes, fencing, etc.—fully one half destroyed. White oak, black oak, laurel, tanbark oak, live oak, pine, madrona, alder, etc., about one half removed in clearing farms—used for fuel chiefly.

No. 2.—The redwood was cut for lumber. Neglected clearings have grown up here and there; where cleaned off, this land proves valuable for farming and fruit growing. Other sorts of timber have been cut, and grubbed out of the way for fuel, to prepare the ground for farming; but much of it remains growing in the pastures, on the slopes, etc.

No. 3.—Patches of brush here and there, in oak clearings, amount to, say five per cent of area. Young trees and sprouts from redwood stumps are rapidly reproducing timber on ten per cent of the area cut off by sawmills. I estimate fifteen per cent a liberal allowance of young growing forest, including planted shade trees, for the timber coming in to replace the original forest in Sonoma County. The redwoods are rapidly disappearing here; three hundred millions of feet of lumber might be sawed from what is left from the Gualala on the north, to their southern limit at Freestone.

No. 7.—In former years immense quantities of timber were stolen by sawmill men and the settlers. It has ceased.

No. 8.—Redwood flourishes from the sea level to two thousand five hundred feet altitude. Tanbark and live oak the same. There is no natural limit in this county to the exclusive habitat of timber, save that the alder and willow grow along margins of streams.

No. 9.—Tanbark is an article of considerable export from this county. It is found chiefly along the coast wherever the redwood grows. Charcoal, also, is burned by parties in cleaning off the land for agricultural uses in large quantities. Orchards are planted, chiefly for home use. Little fruit is exported for lack of railroad communication. Grapes are grown enough to make two and a half million gallons wine yearly. Among other uses to which forests are put is pasturage.

J. B. ARMSTRONG.

SAN DIEGO COUNTY.

No. 1.—The timber standing is pine, cedar, white and black oak, cottonwood, sycamore, willow, and alder; can't give the percentage cut off. The pine is adapted for lumber, and the cedar and oak for fencing.

No. 2.—Part have been cut for lumber and some for fuel, and only a small amount for agricultural purposes.

No. 3.—Quite a large amount of young wood is growing in the mountains—probably from one half to one fourth the amount removed.

No. 4.—As a large portion of the county has no timber, or very little, there is no doubt that it would be very beneficial. The blue gum of Australia does well in the large valleys of the coast. The mountains are well timbered.

No. 5.—Cannot give number of acres—probably one twentieth; but fires in the mountains destroy a large amount of timber every year, and are generally started by campers' fires and Indians gathering acorns. Persons leaving fires should be punished.

No. 6.—Can't answer.

No. 7. Can't say as to present time; considerable has been cut for firewood, posts, and lumber.

No. 8.—The best sugar pine and yellow pine grows on San Jacinto Mountain, at from six thousand to seven thousand feet. Also, on the Cuyamaca Mountains, at from five thousand to six thousand feet. Dimensions, two to five feet in diameter. Three thousand to four thousand feet gives black oak; two thousand to three thousand, white scrub oak; below this come the softer woods.

No. 9.—I know of no nut-bearing trees. The Indians gather a large amount of acorns, and cattle and hogs gather the mast.

CHESTER GUNN.

VENTURA COUNTY.

No. 1.—To a very limited extent, for firewood; live oak and willow.

No. 2.—Wood and fencing, and, to a limited extent, to clear land for agricultural purposes. Quite a quantity has been cut for fuel for oil mining purposes.

No. 3.—No young wood growing except eucalyptus and pepper. Mountain fires completely destroy the fine forests, and there grow up in its place chaparral and chinquapin oak, both worthless.

No. 4.—For fencing and firewood, eucalyptus and cottonwood; advantage of change of climate, as the already limited acreage has very perceptibly increased the rainfall and fogs in the section where these forests are growing.

No. 5.—Nearly one half. Appoint an agent to look after the forests, who should reside in the immediate vicinity, and empowered with authority to stop hunters and other parties from setting out fires. A most stringent law should be enacted.

No. 6.—Since the acreage of eucalyptus and pepper has been increased in the valley, early rains have increased, and the destruction in the mountains of the pine and oak forests have lessened materially the snowfall in that region.

No. 7.—To a very limited extent. Some years ago in Township 4 N., R. 21 W., S. B. M., but I took it upon myself to warn the parties to desist, or I would complain to the proper authorities.

No. 8.—Nut pine at elevation of 2,500 feet; live oak from 300 to 2,000 feet. Three varieties of pine; the pinoul, or nut pine, sugar pine, and spruce; principally located in northeast portion of county, at an elevation of 4,000 to 6,000 feet. Not been invaded for lumber purposes.

No. 9.—None other than wood and fencing, while there is a large extent of tanbark oak in the mountains which has not been used for any purpose.

Respectfully,

DR. S. P. GUIBERSON.

THE FOREST MAP.

At a meeting of the State Board of Forestry, held at the Palace Hotel, on the nineteenth day of May, 1886, Honorable Abbot Kinney, the Chairman, addressed the Commission, stating that he had come to the conclusion that one of the most important acts to be done by the Board, should be the preparation and publication of a forest map of the entire State, showing the amount and kind of timber standing in the different counties, and its commercial uses and value. He proposed that an Engineer be appointed at once, to proceed with the work. Mr. Coleman believed that the duties of the Engineer should be enlarged; that he should be directed to collect data concerning climatic changes resulting from the denudation of timber lands, and, if possible, be clothed with power to make arrests for the illegal cutting of timber, and the setting of forest fires. It was finally decided to adopt the suggestions offered by Messrs. Kinney and Coleman, and Mr. Hubert Vischer, of San Francisco, was appointed the Engineer of the Board, with directions to enter upon his work at once. The report of the Engineer, and the forest map prepared by him, will be found in their appropriate place in this report.

ARBOR DAY.

The movement for the establishment of an Arbor Day, which has been for some time past under consideration by the Board, has lately received additional impetus through the efforts of Messrs. Joaquin Miller, Adolph Sutro, and General Howard, of the United States Army, who are working earnestly in the cause of forestry. Their plan to plant Yerba Island with trees, and to interest the school children in the movement, has done much to bring this subject prominently before the people, and has already accomplished great good. It is not necessary to refer here to the importance of establishing such a holiday, for the reason that the press for months past have been agitating this question, and seem to be unanimous in their opinion of its usefulness and necessity. The bill prepared by the Board, for presentation to the next Legislature, and the passage of which it is hoped will be one of its earliest acts, will be found elsewhere in this report.

The Board takes this occasion to return thanks to Baron Ferd. Von Mueller, of the Phytological Museum of Melbourne, Hon. Norman J. Colman of the Department of Agriculture, Washington, D. C., and Dr. F. Schomburgh of the Adelaide Botanic Gardens, for collections of forest seeds, sent from time to time, which have been forwarded to parties throughout the State interested in tree culture. The Board has sent to Australia, India, Borneo,

and other foreign countries, seeds of our native trees which were thought to be adapted to those climates.

The prevalence of forest fires during the latter part of the present year, and the immense loss to the Government and the State from these conflagrations, led the Board to the printing on canvas for distribution throughout the State of Section No. 384 of the Penal Code, which is as follows: "Every person who willfully or negligently sets on fire, or causes or procures to be set on fire, any woods, prairies, grasses, or grain on any lands in this State, is guilty of a misdemeanor, and is punishable by a fine not exceeding one thousand dollars, or imprisonment not exceeding one year, or by both such fine and imprisonment."

These canvas signs were posted quite extensively throughout the timbered districts, and although no convictions were procured, owing to the difficulties experienced and the lack of means to hunt up evidence, yet it is believed that the warning thus publicly given has had a salutary effect.

FINANCIAL REPORT.

Statement of Expenditures of State Board of Forestry from March 3, 1885, to November 1, 1886.

Appropriation		$5,000 00
Expenditures.		
Salary, Engineer H. Vischer	$752 50	
Salary, Engineer L. Wagoner	171 00	
Salary Secretary	2,112 50	
Seeds, stationery, expressage, postage, etc.	74 70	
Traveling expenses	200 00	
Maps, and photographing same	43 00	
Team, wagon, and outfit, for Engineer	517 98	
Road expenses of Engineer	362 00	
Total expenditure		$4,233 68
Balance to credit of Board		$766 32

SANDS W. FORMAN,
Secretary.

REPORT ON THE FORESTS

OF THE

Counties of Los Angeles, San Bernardino, and San Diego, California.

BY HON. ABBOT KINNEY,

Chairman of the State Board of Forestry.

FORESTS OF LOS ANGELES, SAN BERNARDINO, AND SAN DIEGO COUNTIES, CALIFORNIA.

The term forest, as it is understood in the older States, is applicable in only a limited extent to the natural tree and bush growths of California. Upon the mountain heights alone would an eastern man feel himself to be in a forest. No account of the forests of Southern California would be complete, however, without a description of all the natural tree and brush growths found here.

As has been said, there are no forests, properly speaking, in the valleys and plains. The growths in these portions of the country consist as follows:

On the plains, near the rivers, or in damp, swampy places, willows grow—often in dense, rank groves, and furnish a large amount of firewood. These are also serviceable for manufacturing the finer kinds of charcoal.

The sycamore *(Planus racemosus)* strays down the cañons and watercourses to within sound of the ocean breakers. It is only used for firewood.

In the valleys large groves of oak trees occur. These trees grow from twenty to forty feet apart and are often magnificent old monarchs, most picturesque and attractive. *Quercus lobata*, or white live oak, forms the larger part of the groves; but the red live oak (*Q. agrifolia*), with its dark, glistening, holly-like leaves, is the most attractive. This oak is extensively scattered through the cañons. The oak groves resemble the plantations of the most beautiful English parks. These magnificent trees spread a generous shade over the fields of grasses and wild flowers. Even grain is often planted under them and matures well. It is a great regret to every lover of nature to see such characteristic beauty, so difficult to recreate, rapidly disappearing.

The broader cañons, where there is enough good soil, are enchanting in their careless profusion of verdure. The red oaks, alders *(Alimo oblongifolia)*, sycamores, and maples vie with each other in supporting the grapevines *(Vitis californica)* dependent amongst them. The beautiful bay tree, or California laurel, spreads its perfume amongst many of these cañons. The mountain live oak *(Q. oblongifolia)* is found in their upper portions, and is good for timber. These growths are mixed with trees coming up from the valleys on one side, principally white oaks and elders *(Sambucus glauca)*, and down from the mountain heights on the other, principally spruce *(Abies douglasii)*. These growths are inextricably tangled up with dense chaparral and charmingly ornamented with the large fern brake.

The deciduous trees of the country are almost exclusively confined to the cañons, to the damp lands below them, or to the watercourses. A few, however, are found in the mountains.

As we leave the sea the watercourses, or more properly flood courses, of the country, are bordered by cottonwoods. The species found here are *Populus fremonti* and *P. trichocarpa*. These, like the oaks, frequently form beautiful parks on the damp lands where they grow. One of the handsomest of these groves is at San Jacinto, in San Diego County.

In places on the great Colorado Desert, and on its edges, are found several very useful stunted trees that form, in favorable spots, considerable plantations. These are the ironwood (*Olneya tesota*), *Palo verde* (*Parkinsonia torreyana*), mesquit (*Prosopis tuliflora*), screw bean (*Prosopis pubescens*), and several others of less importance. The mesquit and screw bean are also found scattered in the mountain valleys.

The Piñon pine grows frequently on the desert side of the mountains. These last three trees bear edible fruit, which is collected by and forms the main support of the Desert Indians. In the mountain cañons on the desert side the *Washingtonia filifera*, the striking California palm, is found. The edible oak acorns, the California walnut (*Juglans Californica*), and the seeds of the desert trees spoken of, form important possible sources of food.

In the Mojave Desert the tree cactus grows, which has been made into paper on a large scale by an English company. This is the *Yucca brevifolia*. It grows about twenty to thirty feet high, has an extensive range on this desert, and forms the same grove like plantations so frequent in this dry country.

On the mountains the real forest is found. Considerable quantities of valuable timber exist on the Sierra Madre, San Bernardino, San Jacinto, Palomar, and Cuyamaca Mountains. The Sierra Madre Range has been too steep and inaccessible to tempt lumbermen, since the Mission days, when the southern slope was stripped of its timber. On San Bernardino and San Jacinto large sawmills are continuously at work, supplying the colonies below in the valleys with lumber, but furnishing none for export. Considerable lumber has also been cut on the Palomar and Cuyamaca Mountains. In the mountains are the sources of most of the springs and streams upon which the life of Southern California depends.

Reasonable regulations should prevent injury to these watersheds.

The principal timber cut is pine, spruce, and cedar, the latter being most valuable for posts. The most important trees in the mountains are: *Pinus lambertiana* (sugar pine); *Pinus ponderosa* (pitch pine); *Pinus Coulteri* (nut pine); *Pinus Jeffreyi* (yellow pine); *Pinus Sabiana*; *Abies*, or *Pseudotsuga Douglasii* (spruce); *Juniperus Californica* (juniper berry); *Libocedrus decurrens* (white cedar); *Abies concolor* (silver fir); *Quercus chrysolepis*; *Quercus Kelloggi*.

The timber is said by the lumbermen to be less valuable than that found further north.

The mountain forests and glades—such as Bear Valley, on San Bernardino, and Strawberry Valley, on San Jacinto—are delightful places to visit. The air is clear and bracing, and comes sweet from the pines and cedars, which with us send off a charming fragrance. The brooks are full of trout, and the thickets full of mountain quail, squirrels, and rabbits. These, with an occasional deer, give good provender to the skillful hunter.

The amount of land covered with forest is shown in the accompanying maps. Much territory, however, within the forest belt, has been burned or cut. The map does not show these forest scars, and is therefore not as accurate as we eventually hope to make it.

The low foothills near the coast are generally devoid of trees or shrubs, those on the desert are absolutely bare. With these exceptions, all the foothills and mountains not covered with trees are more or less closely thicketed with evergreen bushes, called chaparral. These grow from three to fifteen feet high, and frequently form an almost impenetrable mass. This chaparral is principally composed of scrub oaks, manzanita, wild lilac, greasewood, and sumac. On the lower foothills this brush is cut and

grubbed up by the roots for firewood. In the mountains and cañons it furnishes feed for the bees, and most important of all, it acts as a reservoir in allowing the rains of the wet season time to seep into the soil and rock veins, to appear again in the dry season as springs in the low country. This brush, together with the trees, also preserves the country from the formation of destructive torrents and floods, and modifies the desert winds, which are already at times detrimental to vegetation. These brush lands nearly all belong to the Government, the State, or the railroad, and being of little direct value will probably long remain their property. Every year disastrous fires sweep off vast areas of this mountain covering. These owners set no watch and take no heed of their property, and the fires run into and destroy the timber as well as the brush. This careless and wasteful destruction of the forests is injuring the climate, the agriculture, and the future prospects of Southern California.

The *Pinus torreyana* has been found nowhere in the world except in a little nook of San Diego County. In the second Sierra Madre Range of Los Angeles County there are a number of redwood trees *(Sequoia sempervirens)*, a fact not generally known, owing doubtless to the inaccessible character of the mountains where they are. In this connection it is proper to call attention to the considerable number of trees and shrubs perpetuated in California that have long since become extinct elsewhere. One may well think it possible that the mild and equable climate where this has happened may be as favorable to man as it has been to vegetable growths.

The necessity of the hour is an intelligent supervision of the forest and brush lands of California, with a view to their preservation in such proportion to the other lands of the State as scientific forestry may demonstrate to be necessary to the welfare of the commonwealth. My views on this subject are embodied in the report of the Board. There are many persons, however, to whom the importance of this subject is entirely unknown. For the benefit of these I have collected a number of instances of what we must expect from injudicious forest denudation. These I submit in a separate paper.

All lovers of nature and all persons familiar with the importance of forestry are anxiously hoping for prompt and intelligent action looking to the judicious management of our valuable forest property.

EXAMPLES OF FOREST DESTRUCTION.

Collected by ABBOT KINNEY, Chairman of the California State Board of Forestry.

CALIFORNIA.

The Southern Pacific Railroad was built into the City of Los Angeles through the Soledad Cañon. Until 1883, no serious damage was ever done this road by floods in that location. But about two years before this time certain parties, having stock pastured on the mountains forming the watershed of this cañon, commenced deliberately to set fires in the brush and forests on these watersheds, the idea being to improve the pastures and keep the trails open.

There are some fifty or seventy head of horses pastured through this

extensive district. These fires destroyed the water-holding capacity of the mountains. As a result, the heavy Winter rains of 1884 washed out the entire railroad, roadway, bridges, and all. Travel and business were delayed over six weeks. The railroad repaired the damages done, and the next year being very dry, no injury happened; but the year following, on an ordinary rainfall, measuring less than many of those that had previously done no damage, the railroad again sustained heavy losses.

Here is the testimony of an eye witness, as published in the Los Angeles *Herald*:

> Mr. Russell Ward, of the fiber company at Ravenna, made his way to the city on horseback, leaving Ravenna on Thursday afternoon and arriving here last night, making a distance of sixty miles in a little over twenty-four hours through quicksand and flood. He rode one horse and led a second, and was often mired in the soft mud. At the fiber mill at Ravenna, the water swept through the mill, and the employés had to be carried out, the railroad switch is washed away and the station nearly gone. Above Lang's Station the $100,000 iron bridge is a complete wreck, part of it being carried upwards of twenty yards down stream. The wooden bridge is also wrecked, and the immense stone work made after the flood of two years ago was carried off like sand. The track in ten or twelve places is wrecked, for varying from twenty to one hundred and fifty yards. Below Lang's the damage is slight until the wash of the Tujungas, this side of the San Fernando tunnel, is reached, but here for miles the road is wrecked. The men from San Fernando reached Ravenna to begin operations for the repair of the track on Thursday. Mr. Ward says the floods came down the cañons in waves seven feet high, and carrying burnt trees and stones in their course. His description of the torrent's force is graphic and frightful.

Now let us take up the watershed of the Tujungas Cañons here spoken of. The watersheds of these cañons have been for some years supplying the City of Los Angeles with its firewood, and the Summer previous to these floods these mountains were devastated by fires. Mr. M. L. Wicks, a large land owner and keen business man, tells me that these fires burned over three thousand acres of land belonging to him in the Tujunga Valley, burning the brush and trees from the mountains. He describes the effects on his own lands as very serious. The rains rushed from the unprotected sides of the mountains, and cut deep and impassable gullies through many places where water had never done any damage before. No injury of a serious character happened to the railroad works at the mouth of these cañons until these causes were set in operation.

It is probably no exaggeration to say that it would have been cheap and good business for the railroad company to have paid Jock Talbot and his friend Texas $5,000,000 to have kept away from the watershed of the Soledad Cañon. The worst thing about it is, that the future promises greater floods in these localities than have ever yet happened.

In this connection it may be well to allude to the results of the small rainfall of from two to four inches in the Colorado Desert falling upon bare and perfectly arid mountains. The description of the floods on this desert by eye witnesses speak of the whole country being apparently one rushing torrent of water. Miles upon miles of railroad track are washed away at once; then, in a day or two, everything is as dry, glittering, and arid as before. These effects are spoken of as the results of cloud-bursts; but no measure of the rainfall taken at Indio or Yuma show as large a fall of water within a given time as occur in our northern, wooded, coast counties, where no such effects are known. So called waterspouts are for the most part the imagined cause of floods not really understood. It must be said, however, that other things being equal, the rainfall in a wooded country does descend more quietly and continuously than it does where there are no trees.

This may be accounted for by the different electrical conditions so clearly

explained by Mr. John Eitel, in the Sacramento papers, and also from the fact that the air above a forested country is in a comparatively homogeneous condition, while that above an arid and treeless land is in layers and currents, whereby great variations in temperature may suddenly be brought in contact, and excessive condensation of moisture take place.

The bee-men of Los Angeles County, whose apiaries have for the most part been in the same situations for many years without damage or thought of damage from floods, were washed away almost everywhere that the watersheds behind them were denuded. Here is another extract from the papers, written at the time, with an account of some of the bee-men's misfortunes, in a year of only average rainfall:

DESTRUCTION OF BEES BY FLOOD.

Great damage has been done to many apiaries in Southern California by the January floods. The greatest damage reported was done to the apiaries belonging to the estate of Ezra May, deceased, the loss being between one and two hundred hives in all. Henry Kiegel lost most of his apiary by flood in the Tujunga Cañon, and the overflow of the Picoma Creek carried away the entire apiary of Holms Maclay. Much damage was done in the Santa Monica Mountains, and the overflow of the Los Angeles and San Gabriel Rivers destroyed hundreds of hives in the low lands. Nor could any foresight have prevented the destruction of bees in these low lands, for no one could possibly foretell that the water would have reached the points it did. As the valleys and mountain sides are cleared of the natural growth of timber and shrubs, the impediments to the rapid flow of water over the land surface are removed, and we may look for greater floods than have heretofore been known, unless this rapid flow of water is checked by growing either timber or grapes on the mountain sides. Where it can be done the bee master should plant trees.

Mr. James Craig, of the Hermitage Ranch, informs me that for some years after the great Edwards fire on the watershed of the Precipice Cañon, that stream diminished in its Summer flow without regard to the rainfall, and is only now becoming itself again. This fact forced itself on Mr. Craig, as his entire water supply came from this stream. In one place this watercourse was filled up sixteen and a half feet, by actual measurement, with sand and bowlders. I am informed that the watershed of my cañon was burned over before my arrival—the traces are still plain in burnt trunks of trees—and that the Summer flow of the spring on which I depend was thereby materially diminished, while during the rains great quantities of sand and bowlders were washed from the mountain, altering the appearance of the cañon.

After my purchase of the property from Mr. Robert Bayley, I ordered a sycamore to be cut down and the stump taken out. On going to see how the work progressed, I found the men digging out a chicken coop frame ten feet below the surface, which must have been buried by the torrent.

About six years ago I settled in the San Gabriel Valley. The road to my ranch from Los Angeles passed through what is now the town of Pasadena, then consisting of one store, a school house, and a number of orchards. The road passed on across the San Pasqual Ranch, most of which was then used to pasture sheep. At that time, between the Arroyo Seco and Precipica Cañon, there was not a single watercourse—not one place where, through pebbles or cuts, a water channel could be recognized. During my residence, until two years ago, no water ever ran across the San Pasqual Ranch between the points named. While these lands enjoyed an immunity from torrents, the foothills and mesas were covered with native growths of brush and chaparral, scrub oak, greasewood, sagebrush, etc. Every succeeding year has seen more of this covering removed from the land by clearing or fire, until now nearly all the mesas are bare of verdure.

Trees and bushes, and in fact nearly all vegetable growth, have a great

power of holding rain water and retarding its flow until it has time to sink into the earth. The leaves, twigs, and branches intercept the rain drops and diminish their force. The roots and the fallen leaves and sticks hold back the water and divide its currents. Besides this, these impediments protect the soil so that it does not cut, thus the water does not get into well defined channels where it can concentrate its force. The humus or soil of the forest and brush land has remarkable powers of absorbing moisture. It is like a sponge, in this respect, a quality of the greatest importance to perennial springs. Thus the destruction of the bushes has caused another change. The rains that were formerly absorbed on these lands are no longer taken in. Torrents have been born; orchards, vineyards, roads, fields, and fences, formerly safe, and which no one ever thought open to floods, have been damaged, partially destroyed, or altogether washed away.

Two years ago a torrent, now very plain, crossed, for the first time, the Mutual orange orchard, Mr. McCullum's orchard, and many other places, going down as far as Mr. Foord's. Last year, though the rains were so light, this torrent ran several times. I crossed it twice while water was coursing through it; but it did little additional damage. This year, however, the rains have already been heavy, causing much injury along the line named. Orange trees and hedges have been rooted up and carried off. In some places deep gullies have been cut; in others sand and gravel have been deposited—in one or two places to the extent of several feet in thickness. Another feature of this year's flood has been the continuation of the torrent's course. It went on cutting through Winston's land to the county road, where it was joined by another new watercourse. This new one came down the Villa Road to the Mission, tearing the road to pieces as it came. The two joined damaged Mr. Foord considerably. Many of his lemon trees—I should say ten or twelve—were washed quite away. His fences and gates were also injured, or carried off by the water. After leaving Foord's the water made deep gullies in the road connecting Rose and Chapman with the school house of the district, rendering the road completely impassable. The torrent ran on, devastating Mr. Titus' large pasture field, and cutting up the main road from Rose's and the St. Anita to the Mission. I know its course no further; but Mr. Leon Rose informed me that these waters seriously injured his father's lands, below this road. Another torrent on the San Pasqual came down Allen Street, cutting the lands of Mr. Hugus and others, and crossing Villa Avenue, made that avenue impassable. Another watercourse came through Mr. Craig's gate into the same road, and another came down near Mr. James Clarke's place, and crossed Villa Avenue there. All this has occurred where no damage nor even mark of damage by water had previously been known.

Further east Mr. William Allen and several smaller land owners have cleared the foothill lands extensively, and consequently several torrents have originated there that have gone on down the valley, injuring the lands of Mr. Crank, Mr. Brigden, Mr. Phillips, Mr. Samuel Chapman, Jr., and others, besides tearing the county road into holes and ditches that make it dangerous to travel. On the upper part of this district I have had for several years a ditch bringing water out of Precipica Cañon, to irrigate my lower lands with. This ditch ran along a bluff that had no cut or marks of a stream passing over it. Two years ago a cut commenced, which obliged me to bridge with a flume the chasm made. This year it has been more deeply cut by what must have been a large body of water. This has rolled out great bowlders, dropped my flume bridge, and left a great projecting talus, or large, broad, fan-shaped pile of glittering rock, where before no such thing was seen. These watercuts are new in the

country. If they have not resulted from the lessened power of the upper lands to hold water by the removal of the brush, what has caused them? It cannot be heavier rains than formerly, because last year there was a small rainfall, still that year water ran in these new torrent beds. Another consequence has been that a well near Monk's Hill, on the mesas, formerly containing thirty feet of water, became dry, and was deepened ten feet more without finding any water.

Mr. E. T. Wright, the County Surveyor, than whom no one is better able to judge, says that during the last Summer a fire had been started on the San Rafael Ranch, which burned over a mountain behind some of his land. This Winter a torrent has come down that has washed away three acres of his property, in a place where there was no torrent track before. The same facts have been observed all along the foothills and mesas of the San Gabriel Valley. Mr. P. L. Washburn, of the *Los Angeles Herald*, who owns four hundred acres in the southern end of Kern County, this side of the Tehachapi, informs me that a similar state of things is going on in that section. He travels over the country in going to his place, and he says that last Summer alone, probably owing to the large influx of settlers, fifty thousand acres of brush and forest land were burned off on the north side of the Sierra Madre Range, from the Cajon Pass west to the mountains where he is. Consequent upon this, the water is cutting gullies in numerous places burned off, or below such places, and is running during the rains in dangerous and destructive torrents. He spoke of one instance on the Cottonwood Creek, where a man had ten acres of corn land swept away by a new torrent that originated in a twice burned off mountain.

Mr. Arturo Bandini, whose family have long resided in Southern California, tells me that his relatives and their vaqueros, or herders, say that in their experience the perennial character of many streams and springs has been destroyed and the pasture injured by the extensive cutting of oak and other trees and the burning of the brush on the mountains. He gives the following special instances: He says the waters of the Arroyo Seco are now less than they formerly were. The woods and brush have been extensively cut and grubbed up by the roots for fuel or destroyed by fire. He also cites the cienega and springs near the ranch house of the "Coyote" Ranch, below Los Angeles. At this place formerly existed large springs and a sort of boggy place, or cienega. It was always the same until the monte or wood of willows around and above it was destroyed and the willows cut for fuel. Since the complete destruction of these willows the springs and cienega have disappeared, and now nothing but a white and desolate plain of alkali remains. Water and wood have disappeared together.

Mr. A. W. Canfield, of Santa Barbara, has recently sent me a valuable illustration of the effect of forest destruction which has come under his observation. Mr. Canfield is a prominent citizen of Santa Barbara, and Superintendent of the Mission Water Company of that city. This is what he says:

> Three years ago a stupid fellow started a fire on the upper waters of Mission Creek, said stream being the main supply for the inhabitants of Santa Barbara City. This fire raged through a dense, heavy underbrush and forest of oak, sycamore, and pine. The enormous heat of the accumulated growth of ages burnt the ground to a cinder, and nearly all the large trees were killed to the root. After the fire we carefully surveyed our chances of reclamation, and decided to try the planting of artificial forest. Cypress and willow were set out, and seeds from the adjacent pines were planted. The heavy rains of the following Winter caused an overwhelming torrent; the soil of the burnt district gave way; landslides occurred; our dam was choked with sand and bowlders at each succeeding flood, and our planted trees and seeds were washed seaward. Since that time the scarp of the mountain stands out bold and desolate; in many places bared rocks

only appear, while the whole upper district of Mission Creek must remain bare of all vegetation. In the lower portion of the burnt district, along the cañon, chaparral has started a new life, and if unmolested further, the brush growth will soon afford grateful shade to the waning stream. This fire has naturally reduced the flow of Mission Creek. A tributary, its east fork, originally of much less volume, still unmolested by fire or axe, now contains nearly, if not quite, the same flow as the main stream.

When I first saw the watershed of Mission Creek, at Santa Barbara, it was covered with a rich mantle of verdure. This growth protected the steep mountain sides, and kept in place the soil and humus. By this means the heaviest rains were so detained as to either flow off slowly or to percolate into the deeper strata, to again appear as springs. Mr. Canfield's observations, as Superintendent of the waterworks of Santa Barbara, show that when the forest covering was destroyed three things happened. *First*—The green trees were replaced by bare, desolate rocks; thus the beauty and attractiveness of the country to strangers was diminished. *Second*—The stream took a torrential character, by landslides and washouts carrying off soil, sand, and rocks, to deposit them again on lower grades in its course. Thus every heavy rain filled up the water company's dam and reservoir with debris. *Third*—While the East Fork, with its watershed forested intact, maintained its usual flow of water, the desolated Mission Creek was so materially diminished in Summer flow as now to contain no more water than its formerly smaller tributary.

Hon. Brice Grimes, of Ventura, informs me that within the last four or five years the Santa Clara River and those of its tributaries whose sources have been stripped of timber and brush, now run more violently and destructively than formerly. As a consequence, the Santa Clara Valley is being much injured by floods. Estimates from individuals on different parts of this river show that between one thousand and five thousand acres of good land have been cut away by changes in the channel of the streams, or covered with debris, so as to be entirely worthless.

Mr. John E. Jackson, for many years County Surveyor of Los Angeles, and at present Land Valuer of the Southern Pacific Railroad Company for the southern counties, has given me the result of his observation of what has taken place here within his experience. He says that there is not a single important watershed in this section that has not been more or less devastated by fire. Equally, that there is not an important watercourse in the section that has not, within his personal knowledge, materially changed in character. Every one of our watercourses, Mr. Jackson says, is now bringing down more sand, bowlders, and debris than was formerly the case. The same rainfall now creates more rapid and destructive floods than it did before the waste of the mountain verdure. The perennial flow of the streams, with equal amounts of rain, is less than it was many years ago. He estimates that thousands upon thousands of tons of the mountain soil are being removed from the uplands and deposited in the valleys, to the disadvantage of both, especially to the water-holding property of the mountains. This effect he attributes altogether to the destruction of the forest and brush lands—principally to their destruction by fire.

INSTANCES IN OTHER PARTS OF THE UNITED STATES.

Mr. Cyrus D. Curtis, of Lamanda, Los Angeles County, informs me that when he was a boy on his father's farm, in Penobscot County, Maine, he was in the habit of catching trout in two streams running through the farm. He says he never knew the streams to fail; they were always perennial. After many years absence he returned to visit the place of his birth.

He found things very different from what he had left them. The course of both streams was wider and more irregular than before, and both ran entirely dry after the month of June. No fish were to be found in either of them. The cause of this was the complete denudation of trees on the watersheds of these streams.

Hon. Brice Grimes, of Ventura, informs me that in 1882, after twenty-nine years' absence, he returned to his father's farm in Lincoln County, Missouri. When a boy, he had been in the habit of swimming in the deeper parts of Lost Creek, and of fishing in the waters of that stream and its tributaries. On his return he found the creek dry, the water holes level beds of sand, and no fish. At the same time, the woods in which he had hunted about the sources of these streams, had been cut off and disappeared.

At my own father's farm, at Brookside, New Jersey, there was a stream called the "Mile Run." It was full of fish—had many deep holes in which we used to swim. After many years' absence I visited the old home. The woods at the source of the stream had gone, and its whole appearance had changed. The bed of the stream was much broader; large portions of the meadows and lowlands had been cut away or covered with gravel, and the stream was a mere thread of water.

Dr. Thomas Rigg, of Pasadena, informs me that Mr. Maynard, a friend of his, some years ago established a saw and gristmill in Ohio. The mill was situated on a branch of the Miami River, the course of which was through a forest. At the time the mill was built, and for years after, the stream that worked it was perennial. Eventually, however, the woods at the source of the stream were cut. The stream gradually diminished, and has now dried up. The mill property is a complete loss.

General F. A. Whittaker, of Pen Yan, New York, now residing at the Highlands Ranch, San Gabriel, writes me as follows:

> The theory that forests have a tendency to increase the fall of rain is a common and accepted one at the East, and facts seem to bear it out. There are many streams and springs, which I remember to have run with full heads, that have disappeared entirely since the woods near them have been cut.
>
> A stream flowing in Keuka Lake was formerly always full of water. Indian tradition says that they always in crossing the stream used canoes. On this stream was built a saw and gristmill and a carding machine. It is now dry a portion of the year.
>
> I bought a farm in 1857; the recommendation was *living water*. The sources of the stream have been cleared, and it is now dry most of the year. The country, as it is cleared up, has a tendency to a less fall of rain. On the Johnson farm a spring was opened, but since clearings near it is now dry.
>
> On my father's farm they are now growing wheat where there was formerly two feet of water. A spring was opened on a farm that I owned at Bluff Point. The excavation is still there, but the water is gone.

General Whittaker also speaks of a great water suit at Pen Yan, in which the evidence from the records of men who had taken the rainfall years before the existence of the Signal Service, showed that the rainfall had diminished since the clearing of the forests. Both General Whittaker and Dr. Rigg say that their observation of showers has been that these rains follow the wooded banks of streams and lakes or belts of woodland, while the cleared uplands are visited much less, and are often left quite dry.

My own experience has been the same in this regard, and I think that showers fall more copiously and more often on such wooded or watered belts than elsewhere.

Dr. A. Kimball was born and brought up near the boundary of Oneida and Lewis Counties, New York, on the edge of the Adirondack wilderness. When he was a boy the forests were intact, and the streams about his home

were filled with trout, which he enjoyed catching. Their average depth was one and a half feet. Now the woods have been destroyed, and the streams have dried up. The doctor told me this in November, 1885, at the Fruit Growers' Convention in Los Angeles.

Here is a quotation from a work that every statesman, farmer, and good citizen should read. It is from the celebrated book by George P. Marsh, "The Earth as Modified by Human Action:"

It is an almost universal, and I believe well founded opinion, that the protection afforded by the forest against the escape of moisture from its soil by superficial flow and evaporation insures the permanence and regularity of natural springs, not only within the limits of the woods, but at some distance beyond its borders, and thus contributes to the supply of an element essential to both vegetable and animal life. As the forests are destroyed the springs which flowed from the woods, and consequently the greater watercourses fed by them, diminish both in number and volume. This fact is so familiar in the American States and the British Provinces that there are few old residents of the interior in those districts who are not able to testify to its truth as a matter of personal observation. My own recollection suggests to me many instances of this sort, and I remember one case where a small mountain spring, which disappeared after the clearing of the ground where it rose, was recovered about twenty years ago by simply allowing the bushes and young trees to grow up on a rocky knoll, not more than half an acre in extent, immediately above the spring. The ground was hardly shaded before the water reappeared, and it has ever since continued to flow without interruption. The hills in the Atlantic States formerly abounded in springs and brooks, but in many parts of these States, which were cleared a generation or two ago, the hill pastures now suffer severely from drought, and in dry seasons furnish to cattle neither grass nor water.

Cassius M. Clay, of Kentucky, has published an account of the effects of his own forest destruction. His father built a large stone mill in the blue grass region of Kentucky. The stream on which it stood was perennial, and the mill ground the wheat grown upon the farm. When Mr. Clay, Jr., came into his estate he girdled and killed all the trees on the hills, with a view to increasing his pasture range. The effects were very different from what he had anticipated. The stream dried up and the mill became useless. It also became useless from another cause, and that was the failure of the wheat crop. Mr. Clay says that the climate of his part of Kentucky has materially changed, owing to the extensive destruction of forests. Late frost, drought, and wind have become very injurious to vegetation. The returns in agriculture have become more uncertain than formerly, and some crops fail altogether. Amongst other crops, wheat on his farm gave no longer a remunerative yield. The old mill was pulled down and the stone used for other purposes. Mr. Clay gives the facts in detail, and publishes them as a warning to others.

George Allison, of Canada, says: "I am satisfied that the sudden climatic changes, now so much more injurious to Canadian agriculture than formerly, are largely due to the destruction of our forests."

The diminished flow of the Hudson River, and of the feeders of the Erie Canal in New York, has alarmed the people of the State. This effect is attributed to the destruction of the forests at the sources of the streams. The State has taken action in the matter, with a view to prevent further forest destruction, and has reserved its own large amount of forest lands from sale.

Mr. Sherman Washburn informs me that on his father's farm in Steuben County, New York, there was a stream that ran a mill situated on it. The forest was gradually cleared at its source and now the stream is no longer perennial, but only flows in heavy rains, for a short time, having lost its character and value.

Hon. H. H. Markham, present member of Congress from this district, in answer to a letter of mine, gives me the following information:

I was born, reared, and have always lived in a timber country, and have watched the effect of timber upon natural watercourses, and I am therefore fortified in my belief that your position is correct. My brother owns a farm in Sheboygan County, Wisconsin, a county heavily timbered. He built a shingle mill on the creek passing through his farm, and ran it by water power, but as the land surrounding him became shorn of its timber and cultivated, the stream diminished and soon became dry. He sold, and purchased another tract in the next county north, and when I first saw it in 1861, there was a stream running through it containing sufficient water to allow him and others to float double-length railroad ties by the hundreds down to market. The surrounding country was rapidly cleared, and within six years the stream became dry, with no water except in rainy seasons.

FOREIGN INSTANCES.

The agricultural editor of the *Adelaide Observer*, in South Australia, speaks as follows of the effects of forest denudation in that country:

We all know that the River Torrens was a deep chain of connected waterholes all along its course, and that it was necessary to have a boat for crossing it in the early days. I have been ferried across the Torrens by Mr. Moorhouse's boys several times as a youngster; but the bed of the river soon filled up, the waterfall that existed at the back of the gaol disappeared, and before the dam was erected it was easy to cross almost dry-footed anywhere; whilst the bed of the river below the slaughterhouse, until late years, was quite dry. The North and the South Paras are also very dry during Summer time, and I have no doubt many other petty rivulets are equally altered in character. Now, each of these streams was thickly shaded with fine large red gums in the early days, and the banks were completely embowered with tall and handsome flowering shrubs. At that time we were used to see a heavy dew upon the ground nearly every morning throughout the Summer. Then the climate was milder than now, and fruits of all kinds ripened a month at least sooner. We were used to very frequent thunderstorms in Summer, which resulted in rains at that period of the year which we do not now experience. As the trees were destroyed by fire and ax the streams filled up and diminished in volume, the thunderstorms in Summer ceased, the Summer dews disappeared, and the ripening season for our fruits became later and later. At first we could get sweet and ripe watermelons at Christmas or New Year's Day; now we generally get them about March, when there are a few ripe and ready for use.

The Volga River in Russia presents a striking example of the effect of destroying forests. Its movement has become an alternation of destructive floods and droughts which render its navigation difficult and uncertain. It is the longest river in Europe and empties into the Caspian Sea. It is about one mile wide in its center part, and two or three miles near and at its mouth. Canal systems connect it with the Neva, St. Petersburg, and the Baltic, and immense as this waterway system is, it is proposed to extend it to Archangel, and the White Sea, and also to the River Don. The incalculable usefulness of this system of navigation has only one serious drawback—the stream of the Volga becomes narrower every year in the dry season, and the floods shift channels and pile up great sand banks. * * * The only remedy for the floods and droughts is to arrest the destruction of the forests, and it is said the Russian Government will attempt to do so. Unfortunately the remedy will not act as swiftly as the evil which in a few years has greatly increased the difficulties of navigation.

Mr. Gervoise Purcell, B.A.C.E., formerly in the employ of the Japanese Government as engineer, has written me a letter containing observations of his while in Japan.

The destruction of forests in that country, consequent on the repeal of the old forestry laws, has produced very serious results. Mr. Purcell's facts from Japan show not only the cutting of torrents into the soil, but the deposit of that soil in the valleys as the slickens have been deposited in the Sacramento Valley when the grade of the stream decreases. As soon as a stream emerges from its steep mountain course to the level valley it must run slower, and at once commences to drop its load of debris. From such deposits many rivers in Japan have so raised their beds, which the inhabitants for self protection have as constantly levied, that when railroads were built it became necessary to *tunnel* under the rivers instead of bridging over them. Here is some of the evidence of Mr. Purcell:

The Kusatsagawa in the province of Oerie, emptying into Lake Biaa, is twelve feet above surrounding country at the Uakaendo crossing, and lower down where it is bifurcated, the branches are thirty feet above the plane. The Ashijagawa crosses the Kabe

Osaka Railway. Lowest point of river bed twenty-two feet above surrounding plane, and to top of levees is thirty-two feet. *The railway passes underneath the river through a brick tunnel.* There are several other rivers under which the same railway passes, but this is a type of them all.

The Kamaisbigawa, over which I built twenty-four bridges, had a flood width of one hundred and ninety-five feet, but owing to the denudation of the timber on the watershed to make charcoal for the smelting works, and to lay bare the iron ore deposits at its source, in the year 1877, after a three days tornado, the flood width was increased to three hundred and ninety-five feet, and high water mark raised six feet. Immense rifts were made in the denuded hillsides, in many instances fifty feet deep at the base. I may add I traced the high water mark of the Kamaisbigawa back one hundred and thirty years. The cutting of timber for smelting purposes commenced in 1873.

I have a large amount of cumulative testimony on these questions, but, as these cited are enough to cover the ground, it will only drag out the report into too great length without doing good to cite more of them. I shall therefore conclude these instances with one direct piece of evidence of what overpasturing in forests and mountains, and the consequent killing of the young growth, so that as the forest dies out or is destroyed it is not renewed, does to the country and to these pastures themselves. It is a case of killing the goose that laid the golden egg.

Arthur Young, one of the most attentive observers who has left memoirs of his travels, wrote, in 1789, a description of the country about Barcelonette, in France. He says, as cited by Marsh: "The hill pastures feed a million of sheep, besides large herds of other cattle;" and he adds, "with such a soil and in such a climate we are not to suppose a country barren because it is mountainous. The valleys I have visited are generally beautiful." In 1806 Hericart de Thury said of the Valley of Embrun, in France: "In this magnificent valley nature has been prodigal of her gifts. Its inhabitants have blindly reveled in her favors and fallen asleep in the midst of her profusion."

Now let us see what has happened to these beautiful countries after the trees and undergrowth on the mountains were destroyed. Blanqui, a celebrated French political economist, in a memoir published in 1843, says:

The clear, brilliant, Alpine sky of Embrun, of Gap, of Barcelonette, and of Digue, which for months is without a cloud, produces droughts interrupted only by diluvial rains, like those of the tropics.

The abuse of the right of pasturage and the felling of the woods have stripped the soil of all its grass and all its trees, and the scorching sun bakes it to the consistence of porphyry. When moistened by the rain, as it has neither support or cohesion, it rolls down to the valleys sometimes in floods resembling black, yellow, or reddish mud, sometimes in streams of pebbles and even huge blocks of stone, which pour down with a frightful roar, and in their swift course exhibit the most convulsive movements. * * * The elements of destruction are increasing in violence. The devastation advances in geometrical progression as the higher slopes are bared of their wood; and the ruin from above, to use the words of a peasant, helps to hasten the desolation below.

The Alps of Provence present a terrible aspect. In the more equable climate of northern France, one can form no conception of those parched mountain gorges, where not even a bush can be found to shelter a bird; where, at most, the wanderer sees in Summer here and there a withered lavender; where all the springs are dried up, and where a dead silence, hardly broken by the hum of an insect, prevails; but if a storm breaks forth, masses of water suddenly shoot from the mountain heights into the shattered gulfs, waste without irrigating, deluge without refreshing the soil they overflow in their swift descent, and leave it even more seared than it was from want of moisture. Man at last retires from the fearful desert; and I have the present season found not a living soul in districts where I remember to have enjoyed hospitality thirty years ago.

Thus we have the evidence of accurate observers as to the beauty and productiveness of this part of France; and we have also the testimony of scientific men as to the desolation that now reigns in these districts which has followed the destruction of the forests and undergrowth. Marsh shows that the denudation of the mountains in Provence did not commence until the close of the fifteenth century. At that time Provence was the wealth-

est and most celebrated par of France. In the sixteenth century the destruction of forests was great. In the seventeenth, we see the statistics changing. Marsh says:

> There was an alarming decrease both in the wealth and in the population of Upper Provence and Dauphiny, although by the clearing of the forests a greater area of plow land and pasturage had been added to the soil before reduced to cultivation. It was found, in fact, that the augmented violence of the torrents had swept away, or buried in sand and gravel, more land than had been reclaimed by clearing; and the *taxes* computed by fires or habitations, underwent several successive *reductions* in consequence of the gradual abondonment of the wasted soil by its starving occupants. * * * * * * *

The physical decay of the uplands was such that considerable tracts were deserted altogether, and in Upper Provence the fires (or habitations), which in 1471 counted eight hundred and ninety-seven, were reduced to seven hundred and forty-seven in 1699, to seven hundred and twenty-eight in 1733, and to six hundred and thirty-five in 1776; and this while those parts of France not subject to torrents were rapidly increasing in wealth and population. Provence, in climate and soil, is very like Southern California. Causes in active operation here have injured the whole of that once fertile and beautiful country, and altogether ruined much of it. These causes ought to be suppressed and stopped.

The people of France have long since recognized the value of forests as holders and distributers of moisture, as well as for other purposes, and they have a well regulated system of forest preservation, whereby the products of the forest are used and bring in a vast revenue, of from two to three dollars per acre a year. And still, the cutting is so regulated as to insure a new growth, and prevent the birth of torrents. A sensible and progressive people like we Americans, should certainly not wait for ruin and desolation to force us to enormously expensive reforestation, which would still leave the productive lands once destroyed forever desert.

KINNELOA RANCH, LOS ANGELES COUNTY, CALIFORNIA.

REPORT ON THE FORESTS

OF THE

Counties of Amador, Calaveras, Tuolumne, and Mariposa, California.

BY LUTHER WAGONER, M.E.

FORESTS OF AMADOR, CALAVERAS, TUOLUMNE, AND MARIPOSA COUNTIES, CALIFORNIA.

San Francisco, Cal., August 9, 1886.

Hon. Abbot Kinney, *Chairman State Board of Forestry:*

Sir: I have completed the examination of the condition of the forests in Amador, Calaveras, Tuolumne, and Mariposa Counties, and submit the following report. My examination has, in general, been confined to the central and lower parts of the above named counties, excepting a special trip to the summit of the Sierras, via Sonora and Mono Road; the remainder of the information was procured from the citizens and officials of the various counties.

THE SOIL.

Beginning at the foothills, the rocks are principally slates, with occasional bands of granite and serpentine. This belt is thirty to forty miles in width, and at its eastern limit, three thousand to four thousand feet above the sea level. Eastward, and to the summit, the country rock is granite, and in many places capped by volcanic rocks. Where the latter has decomposed and blended with the granite and slates, the soil is stronger, and the trees are larger and more numerous than where a purely granite soil exists; this is very apparent in the high Sierras, the trees growing in the valleys not being as large and perfect as those at the same level, but having a mixed soil. The most perfect specimens of trees are found, as a rule, near the foot of a hill, or on gentle slopes, where the soil is easily retained and always renewed by the wash from above.

COMPOSITION OF THE FORESTS.

The following table will give an idea of the percentage and distribution of the principal trees, the lower limits being averages, and the upper limits are those observed on the Sonora and Mono Road. The table refers to the original state of the forest before any cutting was done.

The belt covered by any species might be very nearly represented by contour lines nearly level, the lines being isotherms, or perhaps more accurately, by contour lines having certain fixed means of heat and moisture for the upper and lower limits. There are some exceptions to this for lower limits, as on streams; thus tamarack is usually found above six thousand feet elevation, but one case is reported of finding a few trees on the south fork of the Stanislaus, at about four thousand feet elevation.

three thousand one hundred feet elevation. Practical measures should be taken to plant trees having an economic value, such as hickory, ash, and black walnut. The forests of this State being notably deficient in the valuable hard woods, their cultivation would be of great utility.

Annexed to this report is a map of the four counties upon which I have traced the present line of timber fit for sawing into lumber. This line has moved eastwardly about fifteen miles, or half a mile per year, but at present the rate of cutting is not so great, for two reasons: The present line is near the heart of the original forest, and it yields more per acre; also, the demand is not so great as in former times.

There is also accompanying this report a set of photographs, taken August third, on the Sonora and Mono Road, to illustrate the different trees and their distribution in the high Sierras.

Very respectfully,

LUTHER WAGONER, M.E.

County, California

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REPORT

ON THE

Trees and Shrubs of San Diego County, California.

BY C. R. ORCUTT.

TREES AND SHRUBS OF SAN DIEGO COUNTY, CALIFORNIA.

The northern part of San Diego County seems to form the southern limit of many of the trees and shrubs of the State, while on the other hand the southern part possesses a considerable number from the southern, or Mexican, flora. The county may be otherwise divided into the (1) coast region, where only a few shrubs and bushes may be found, with the single exception of the Soledad pine; (2) the lower foothills, including the larger valleys near the coast and the numerous cañons; (3) the higher foothills and the mountains below four thousand feet in altitude; (4) the mountains above four thousand feet; and (5) the desert region. As it will be of interest to know the limit of the distribution of our trees and shrubs, I add notes on those found extending southward into the Californian peninsula. I will now note the ligneous plants in their natural order.

Berberis Fremonti, Ton., is found near the desert in the southern part of the county, and in the mountains of Lower California. *B. Pinnata*, Lag., is found among the foothills but not abundant. These barberries are of no value.

The poppy family gives us the *Dendromecon rigidum* throughout the foothills southward, and the *Romneya coulteri*, which is found abundant as far south as San Vicente Mission, growing in the valleys and on the sides of the mountains.

Isomeris arborea is a small shrub found near the bay and southward.

Fouquiera splendens extends into the county along the desert borders from the south.

Malvastrum Thurberi, abundant on the mesas near the city, extending farther inland.

Fremontia Californica extends from the north into the peninsula near the boundary. This forms a small tree, and bears beautiful abutilon-like flowers.

Larrea Mexicana is a desert shrub.

Cueoridium dumosum extends from the coast into the foothills, southward into the peninsula.

Euonymus occidentalis finds its southern limit in the Cuyamaca Mountain.

Zizyphus Parryi, *Z. lycioides*, var. canesceus, and *Condalia spathulata*, are small desert shrubs. *Rhamnus crocea* extends into the foothills and southward; *R. Californica* and a variety taking its place in the mountains.

Adolphia Californica is a small bush, abundant near the city, that becomes a fair sized shrub further south in the peninsula.

Of the wild lilacs, *ceanothus*, *sorediatus*, *divaricatus*, and *cuneatus* are abundant near the coast back into the foothills, and even extending into the mountains, where *ceanothus integenimus* is also found. *C. rigidus* is found in the northern part of the county. The first named species extend into the peninsula as far as San Vicente.

Vitis Californica grows in some of the cañons back from the coast, but has not been observed southward.

No buckeye is known in the county, but *Æsculus Panyi* is found along the coast from north of Todos Santos Bay to Rosario, in Lower California, and forms a low shrub, the trunk with a dimaeter of a few inches to a foot or more.

Acer macrophyllum is found in the mountains in the northern part.

The sumacs are abundant, and all extend southward into Baja California. *Rhus laurina* is common near the coast in little cañons and among the foothills, where it forms large clumps, twenty feet or more in height. *R. integrifolia* forms a low shrub nearly a foot or two high on the ocean beach, but in the sheltered cañons near by it becomes a small sized tree. On Todos Santos Bay, Lower California, I have seen the trunk nearly two feet in diameter, and fifteen to twenty feet high. *R. ovata* takes its place in the higher foothills. This species produces a sugar which is collected by Indians sometimes. The fruit, like the preceding and other species, is red, a pleasant tart, and when put in water makes a cooling drink. The fruit is also credited with medicinal qualities.

The poison oak, *rhus diversiloba*, is also abundant throughout the county and southward usually near watercourses.

Rhus armatica, var. *trilobata*, and var. *indivisa*, are found among the hills and mountains, the latter extending into Lower California. They are merely small bushes.

A large shrubby lupine, *Lupinus albicaulis* or *L. douglasii* (perhaps both species), is found among the hills; abundant south.

Proralea macrostachya and *Amorpha Californica*, are tall, slender shrubs, belonging to the leguminosæ, common near water among the foothills, and extending southward; the latter also growing in the mountains.

One or more shrubby daleas are found on the desert and in the cañons leading to the desert, where are also found various other small trees like the iron wood, *Olneya tesota*, *Parkinsonia torreyana*, *Palo veide*, *Prosopis juliflora*, *Mesquit*, *Prosopis pubescens*, screw bean, and *Acacia greggii*. The three latter species are found west of the Sierras also, and extend southward among the foothills, often forming the only trees in many of the larger desert valleys.

Primus ilicifolia, oak-leaf cherry, grows throughout the county, southward. *P. demissa*, our choke cherry, is found in the high mountains of the northern part. *P. fremonti* and *P. fasciculata* are desert shrubs, the former abundant near the coast, also south of Todos Santos Bay, Lower California.

Chamæbatia foliolosa, the tar bush, is found on some of the mountains and hills near the coast and southward. *Purshia tridentata* is a small desert brush.

Cercocarpus parvifolius, the feather tree, grows twenty feet high or more in favorable locations, and is abundant throughout the county, and southward among the foothills.

Adenostoma fasciculatum, or greasewood, forms a considerable part of the firewood brought into town by Mexicans, and covers large areas of mesas and hills throughout the county from Port Lama into the mountains, and southward as far as San Telmo. *A. sparsifolium* largely takes its place among the lower mountains, and is generally called deer brush. From two to ten feet is the usual height of both species.

Rosa Californica and *Heteromeles arbutifolia* extend throughout the county into Lower California.

Several species of *ribes* grow in the county, but are of no value.

Cornus Californica is found as far south as Cuyamaca Mountain. *Gauya flavescens*, var. *Palmeri*, is a small shrub found among the mountains

along our southern frontier, extending into the higher mountains of the peninsula.

Sambucus glauca, elder, grows in abundance, sometimes attaining considerable size.

The composite shrubs are various species of *baccharis*, *pluchea*, *borealis*, *hymenoclea salsola*, and *moagyra*, several *artemisias*, and a *tetradymia*, which constitute a large part of the brush along our watercourses and on our hills.

Six kinds of manzanitas are also known with us. *Arctostaphylos bicolor*, growing near the coast, *A. oppositifolia* and *A. diversifolia*, straying near the border from Mexico, and *A. pungens*, *glauca*, and *tomentosa*, which extend from the north through the mountains into Lower California.

Rhododendrar occidentale is found in Cuyamaca Mountain—doubtless its southern limit.

Fraxinus Oregana—Oregon ash; possibly strays into the county on the north, and *F. dipstala*, the beautiful flowering ash, which forms a small tree, strays in from the south. Two kinds of yerba santa, credited with great medicinal properties, are found in the county—*Eriodictaon tomentosum*, near the coast, and *E. glutinosum*, among the hills and mountains. A third and more valuable species is found around Todos Santos Bay, where it takes the place of *E. tomentosum*.

The tobacco tree, *nicotiana glauca*, though not a native, is fairly naturalized near the city. Several species of *lycium* grow in the county, some ten feet high or more.

Miumlus glutinosis and *M. puniceus* are small bushes bearing beautiful and showy flowers in the Spring. The latter grows near the coast.

Chilopsis saligna, the desert willow, is found on the desert border, at Jacumba.

The white sage, *Andibertia polystachya*, is scarcely more than brush, but grows six to ten feet high, and forms an important plant, making excellent bee pastures. *Andibertia stachyoides*, *A. trichostema*, *Eriogonum fasciculatum*, *Atriplex canesceus*, *Eurotia lanata*, of the desert, etc., are other kinds of brush that can scarcely be called shrubs.

The laurel, *Umbellularia Californica*, extends into the county from the north, and is said to be found on Cuyamaca Mountain.

Sycamores, *Planus racemosus* are found along the watercourses, among the hills, as far south as San Quentin Bay, Lower California.

Simmondia Californica, common around San Diego and in the cañons, often forms a small graceful tree south of the line. Along San Diego Bay it grows scarcely two feet high. It bears an oily nut that is not unpleasant eating. *Euphorbia misera* is a small shrub, extending from Point Loma southward among the hills, near the coast, to Rosario, Lower California. *Acalypha Californica* very rarely becomes a small shrub.

Alnus oblongifolia is found near the headwaters of the San Diego River, in the Jamacha Valley, and on the mountains, growing to a height of forty feet or more, and a foot in diameter.

Willows are found along the watercourses throughout the county, *Salix lasivlepis* probably being the commonest species. Cottonwood are abundant in some of the inland valleys, *Populus fremonte* var. *wislizeni* being the species common in the south. *P. trichocarpa* strays into the county in the north, as also *Juglaus Californica*—the wild Californian walnut, and *Castanopsis chrysaphilla*.

Quercus dianosa—a worthless shrub oak—is common throughout the county, and southward another shrub oak, *Q. pungens*, strays into the

county from Arizona, and is found near camps on the southern boundary with *Q. Dunnii*—the holly-leaved shrub oak which is better known as *Q. Palmeri*. The Californian live oak, *Q. agrifolia*, grows abundantly among the hills, reaching an elevation of five thousand feet, and is found southward in the peninsula to near the Sta. Tomas Mission. This furnishes a large part of the oak wood that is used in San Diego. *Q. oblongifolia*, known as the post, or white oak, is found among the valleys and higher foothills. *Q. Emoryi*, a small tree, extends into the mountains of Lower California south of the line, and may be found in the county. *Quercus Kelloggi* and *Q. crysolepis* are found in abundance on Cuyamaca Mountain northward, and I have seen a few stunted trees of the latter near Hanson's Ranch in Lower California.

Juniperus Californicus is not rare on the mountains, and extends northward into the peninsula to near the coast among the foothills. Two kinds of cypress grow near the city among the hills, one probably *Cupressus macrocarpa*, and the other a stunted form of the beautiful Guadaloupe Island cypress, *Cupressus guadaloupensis*, which extends south into the peninsula.

The only survivers of *Pinus tonrryana*, a small tree belonging to a past age, are found along the ocean bluff at Soledad twenty miles north of San Diego. Near Elsinore a few pines are found that seem to belong to *Pinus tuberculata*. On the mountains east, at an altitude of six or seven thousand feet, are found the sugar pine—*Pinus lambertiana*, *Pinus coulteri*, *Pinus pondersoa*, *Pinus sabiniana*, and the *Pseudotsuga douglasii*, var. *Macroscarpa*. At Pine Valley and elsewhere, are found the large yellow or bull pine, *Pinus jeffreyi*, which extends south into the Lower California mountains, where they form large forests at Hanson's ranch. Coulter's pine also extends into Lower California, but seems exceedingly rare. On the table lands overlooking the desert are found the two piñon or nut pines, *Pinus monophylla* and *Pinus parryana*, which are found sound in the broad table lands of Lower California to an altitude of six thousand feet, where *Pinus parryana* predominates over the more northern species, which seems to be restricted to a narrow belt next to the desert.

Mr. Robert C. E. Stearns, Ph.D., of Berkeley, publishes in the *American Journal of Forestry*, as quoted by Dr. Chipman, the following statement as to the profits of planting the *Eucalyptus globulus*: "General Stratton planted forty-five acres in eucalyptus in 1869. Recently twenty acres of this artificial forest have been cleared to make room for an orchard, and after charging every item of cost and a yearly rental of five dollars per acre, the net profits, as shown by the owner, are $3,866 on the twenty acres in eleven years." Dr. M. M. Chipman also cites in an article on the Importance to Health of Forests, published in the transactions of the Medical Society of the State of California, the statement of Mr. George A. Nadeau as to the value of a eucalyptus grove under his control, seven miles south of Los Angeles. Cost of trees at the time of setting out $7 50 per acre; labor of replanting, $5 per acre; after cultivation, $5 per acre; rental of land at $3 per acre per annum, amounts to $21 per acre for the seven years; total cost per acre for the seven years growth, $38 50. The estimated average amount of the wood on the land is thirty-five cords per acre, which is worth in that locality $3 per cord in the tree, giving $105 per acre as the present value of the timber; or the total cost of the body of timber, $3,734 50, and the present value, $10,185; net profit, $6,450 50." These eucalyptus grow readily and rapidly from the stump, and produce with little care and in a short time, another merchantable crop. It must be borne in mind, however,

that the *E. globulus* only does well in at least a moderately moist situation, as has been before stated in this report.

Last, but not least, are the beautiful California palms so highly prized by horticulturists. The fan palm, *Washingtonia filifera*, is found abundant in the cañons leading to the Colorado Desert, where also are found a few of the blue palms, *Erythea armata*. Other varieties or species may exist, as these magnificent trees are little known, and new discoveries likely to be made when our desert borders are more fully explored. These palms are found in Lower California in the desert cañons, and also west of the mountains, the Washingtonia appearing in a few cañons at Valle de Los Palmas, Lower California (about fifty miles from San Diego), and the blue palm growing near San Quentin Bay.

In this hasty outline of our native trees and shrubs, and of their distribution, it seems desirable to add that nearly all of the shrubs mentioned in the preceding, disappear one by one as we proceed southward along the coast road in Lower California, and other plants—mainly cactus—take their places. The more common shrubs continue as far south as San Quentin Bay, where the last of the trees, and many of the shrubs, will be left behind, and there the botanist will enter upon the dividing belt between the tropical and the temperate floras.

C. R. ORCUTT.

FOREST TREES FOR PROFIT.

By MILTON THOMAS, Esq., Los Angeles, California.

FOREST TREES FOR PROFIT.

To Abbot Kinney, *Commissioner of Forestry:*

I have been requested by you to prepare a paper on the planting of forest trees for profit. I will say that I have had some experience in that line, having planted forty acres of blue gum; also, some red gum, catalpa, and black walnut; and I intend to plant out sixty acres more this coming Winter, and will plant the red variety, and some black walnut. I prefer the red gum *(Eucalyptus rostrata)* to the blue, from the fact that the red splits readily, and is much easier worked up into wood. The blue gum is hard to split, and costs much more to put into marketable shape. The red gum endures the frost well. Frosts that would injure the blue gum, and in some instances kill them, do not injure the red at all. The red gum does not grow quite as rapidly as the blue, but upon the whole, I certainly would advise people that want to raise a forest of timber for profit, to plant the red gum. Some plant these trees eight by eight feet, others six by ten feet. I planted ten by ten feet, believing that when they are six years old or older, I would have more timber to the acre than those who planted them nearer together. I have noticed that trees planted at a reasonable distance are always larger than those very near together. I believe that it has been demonstrated beyond a question that almost all kinds of trees or vines pay better planted at some distance from each other than where they are too near. Now, as the profit to be derived from planting forest trees is the most important question of any to one who desires to plant a forest, I will commence at the beginning by supposing that an individual wishes to plant, say, sixty acres. This would take twenty-six thousand one hundred plants.

Twenty-six thousand one hundred plants, at ten dollars per thousand	$261 00
Planting them out	175 00
Plowing the land eight to ten inches	150 00
Harrowing and pulverizing	40 00
Man to cultivate and care for, six months	360 00
End of first year's work	$986 00

The second year will require a man eight months, at $60 per month, including team and board, which would amount to $480. After that there would not be any expense to amount to anything. Total amount the first year, in round numbers, $1,000; the second year, $500. I have made liberal allowance. Having had experience, I am prepared to say that these are the outside figures. If the trees are well taken care of when a year old they ought to average twelve to fifteen feet in height, and the second year thirty feet; and when five years old will pay a handsome profit. There being four hundred and thirty-five trees to the acre, eight trees when five years old will make a cord of stove wood, worth $9 per cord, which will cost half this sum to have it prepared for and delivered to consumers, leaving a net profit of $243 to the acre, or $48 60 net per acre per annum

for each year of the five; and in five years after there will be as much or more wood as at the first cutting. It is quite possible that this timber will be used for various purposes, in the near future, that will make it still more profitable. It will be readily seen that after the first planting there will not be any expense, as all that is ever required, after the timber is removed, is to take off some of the sprouts. There is no reason why one planting will not last for fifty or one hundred years, and pay interest on a value of $500 per acre. The best time to plant in this county is February or March.

MILTON THOMAS.

LOS ANGELES, CALIFORNIA.

EXPLANATORY CATALOGUE

OF A FEW

FOREST TREES AND SHRUBS FOR CULTURE.

BY THE STATE BOARD OF FORESTRY OF CALIFORNIA.

"But I behold a fearful sign!
To which the white men's eyes are blind;
Their race may vanish hence, like mine,
And leave no trace behind,
Save ruins o'er the region spread,
And the white stones above the dead—
* * * —I would the plain
Lay in its tall old groves again.

Before these fields were shorn and tilled,
Full to the brim our rivers flowed;
The melody of waters filled
The fresh and boundless wood;
And torrents dashed and rivulets played,
And fountains spouted in the shade.

Those grateful sounds are heard no more,
The springs are silent in the sun;
The rivers by the blackened shore
With lessening current run;
The realm our tribes are crushed to get
May be a barren desert yet."

—BRYANT'S *Vision of "An Indian at the Burial-place of his Fathers."*

USES OF FORESTS.

If forests served no other purpose than to provide wood for fuel and timber for innumerable constructive arts, there would be less need to confirm and to enforce economic and utilitarian views which are so manifold and so manifest to us all. Nevertheless, a well certified basis of statistical facts upon any subject of inquiry serves greatly to enlarge the horizon of observation, and bring home to us some adequate realizing sense of the importance of the questions involved; and if for no other reasons than these trite, grosser, selfish considerations, an enlightened lumbering interest would surely command our earnest and active coöperation. But it is not to be supposed that this generation will prove unworthy sons of a patriotic and public spirited ancestry, for no wisely enlightened, social, or civilized man liveth solely to himself. Hence, the public domain—the whole people's patrimony, and their generations, in the largest sense of the general welfare, which we have inherited, in trust, for all time—must be generously passed onwards, with our share of use and of improvement, to children's children, unto all generations! This is the paramount present duty; the loftiest foresight, forethought, providence; in short, the good citizen's highest moral charity.

"Till the forested wilderness become a fruitful field, and the fruitful field be esteemed a forest."—XXXII Song of Isa. 12th.

After all hitherto deprecated by devoted lovers of nature and the most earnest scientists, the wisest statesmen and philosophers, still the fearful forest crusade goes on. When, too, the general will of the people is enacted by upright and practical legislators into the best forms of sylvan supervi-

sion, with due restraints on consumption, and waste of woods; and even, as it were, the amplest utilization of *all* their resources (so far as yet known); nevertheless scarcely a tithe of their wondrous uses can be justly said to be duly appreciated, mainly, let us hope, because their inestimable value to individual, State, or nation, and the wide world at large, is so little understood.

Let us, then, in the briefest possible manner, bring forth out of the common treasury of knowledge a few preliminary reasons—new and old—why trees lay claim to our high consideration. Passing strange, as it may seem, we *all* need line upon line, precept upon precept, upon paper, for lack of the heart of a noble and wise humanity within us.

It is because these great social and civil questions require joint action as well as individual effort, that Boards of Forestry in every enlightened nation of the world are now a conceded and urgent necessity. In the vast and ever increasing realm of man's material interests, it is impossible to overestimate the value of trees and shrubs to the wealth and prosperity of a nation, or of mankind in all the habitable regions of the great globe itself. Among the highest forms of the vegetable kingdom, therein they are the militant police, the picket guards, rank and file of those others that undoubtedly rule by "divine right" over all the subordinate products of earth. Fain as we are to enlarge we must be brief.

It would be interesting, could we spare space and time, to trace with some degree of fullness the beneficial effects of forests on clime. Like outer bars and reefs, that divide and conquer raging currents and rolling billows, so also do trees in the firmament above the waters, likewise endless, twig, spray, branch, limb, and massed body, the wind-waves of the great aerial ocean, storm-tossed too and tempest-born, into our own calm desired haven, the quiet human habitation of shelter and of repose. As vast masses of air can not be uniformly superheated over broken forested areas, they banish cyclone and sirocco, blasting and mildew, limit the ravages of rust and other fungi; not only forestall the breeding of locusts and numberless insect plagues and pests, but stay their progress and give ample shelter and protection for their compensating enemies in kind, besides feathered aids of every wing; they lay quiet finger on the chill and most trying norther, and next to the sun itself, render subtropical culture possible in the northernmost temperate zones; retain, restore, and equalize humidity, and, as before suggested, control the flow of springs and streams, lakes and wells; condense as by precipitating visible and invisible streams, also draw the passing cloud to refreshing shower, and not only arrest passing fever-laden miasms, but prevent the original formation, probably nearly all more or less, notably *eucalypti*, some of which absorb three or four times the sickening marsh that our oaks and elms are wont; and hence, evaporate a like amount of purified and salubriously camphorized and well medicated humidity to slake the thirst of a feverish atmosphere. We have thousands of similar sylvan alembecs ready at our bidding to sweeten earth and air, abounding in large stomachal or breathing pores, like insects, and exhaling ethereal fragrance, creating aroma, almost equal in rapidity with the lightning of the thunder cloud itself; hence, they disinfect by natural vital processes, and also mechanically bar the deadly progress of unnumbered plagues. They are also the natural home and secure retreat of feathered insectivora and the song bird, greedy of living pests and the tree-destroying mistleberry. Like some animals, these subserve as primitive forest planters, and may, ere long, with the useful insect aids against the common enemy, receive some just protection and fostering care at our hands.

It cannot be too strongly impressed, as suggested, how forests draw and condense the moisture of clouds, lowering temperature in Summer and raising it in Winter to a more moderate mean; in short, by all ways and means of varied conditions mitigating our lot—sheltering men and animals, fruits and fields—even to the dollar and cent estimate of millions of millions annually; nay, the very earth itself from exhausting sun, wind, and soil-wasting washes of the stormy season. Then their decaying leaves lend a spongy, mulching mantle to retain these rains, and to cushion the hoof of herd and flock, lest the tramp and traffic of men and things mortar the clayey loam while yet too wet, as it were, to tales of brick-mud, and so left bared of nursing bush to bake hard and impervious as the stone in the burning sun—whence the rough, almost lifeless, deeply-fissured bark—ready prey to the beetle and other borers—for wheresoever the expiring carcass is, thither do they gather themselves together to be in at the death.

Vigorous trees in spreading prim, let it be remembered, reabsorb a large amount of moisture from the air at all times, as well as restore never-failing dews that refresh the vegetation of their extended vicinity. These exhaled dews are not of the filthy, sickening, fen-sucked sort, but "sweet as the breath of kine that feed on ambrosial meadows;" their roots also powerfully loosen and lift up even the lower subsoils, or disintegrating the high places they bring down from the great mountain storehouses of nutrient materials the potash of rocks and other needful chemical supplies—always prospecting below and bringing up from the deep moraines over which they grow abundant renewed rich, ready-made soil ingredients for man's varied uses. In a word, their lofty masts and broad sails, unfurled to every breeze, bound on the long voyage of ages, yet is ever bringing bountiful supplies unto all living; but who among us can recount all their munificent benefits—who knoweth the metes and bounds of their electric and more occult spheres and compensating benign influences—their high, ruling endeavor toward the balances of power in the vegetable realm—the principal part they play on the boards of the great theater—and altogether what music they render in the orchestral harmonies of nature, in her grand oratorio!

Reference to trees as to food for men and animals, for clothing, and for medicine, and the like, the merest hints must suffice; and we purposely avoid poetic, artistic, and sentimental sympathies, or as to sacred represented types of invisible and eternal realities, or as to any hoary superstitions of the past, or hypothetical credulities of the present, but chiefly and somewhat narrowly limit these notes to secular uses only.

Concluding our needful proem, a pertinent question arises: Would it bring this very brief sketch into stronger light and bolder relief by casting in a few black shadows? If so, let us return and view the subject from opposite, or disorderly contrasts. And just here a thousand instances multiply upon us; but take a miniature typical example—a continent in the small—under the most favorable conceivable auspices; an isle (Mauretius), the "pearl" of the Indian Ocean, resorted to by invalids from all parts of India on account of its salubrity, being one mass of verdure; at length the forests were all cleared off for sugar planting; forthwith the rainfall almost ceased; rarely a thunder shower any more; rivers dwindle to muddy, lingering streams; lagoons, swamps, and marshes, especially along the seaboard, now no longer filled with waters, gave off noxious gases; little sluggish streams became filled with impure wash-water and obstructive refuse, and although often inundated in the rainy season, anon followed by dryness, augmented by faulty sewerage, fevers of a low type set in, against which

the usual remedies proved utterly valueless. Men often fell in the field, and died in a few hours; and this, mind you, in mid-ocean! (So reports Dr. H. Rogers, of that isle, who insists that the forest on the plateau must be replanted *for sanitary reasons alone*, as given by the celebrated Ferdinand Von Mueller, of Australasian Forestry Commission, and republished in California by Mr. E. Cooper.)

We have seen this whole programme enacted in the self-same series on Silver Run, and several other streams in Alabama, Georgia, south, west, and southwest to Texas and elsewhere, numberless neighbors in apparently perfect health, attending their usual round of morning and day duties, fall in the field, and laid out a corpse before night. Nay, we have attended whole cohorts of thirty to forty on a single plantation, all down at once, and this, time and time again, where we have pioneered the practice of medicine, more or less, Atlantic or Pacific, now well-nigh half a century. These present observations could be multiplied *ad libitum*, to very weariness, were it worth while, for the rank and file of those to whom such an appeal is likely to be of any benefit at all; could cite published facts of the day of hundreds upon hundreds struck dead by filthy ditch-mud, until it was somewhat a little easier to cart off dead humanity than "slickens." Indeed the whole subject is a matter of such universal notoriety it seems a pity not to mention something an average intelligent people do not know. The only plausible excuse to offer the public for these platitudes is that we do not in general sufficiently *realize our peril*, or something else too heinous to be dealt with in this way. However, there must always needs be the last appeal; the final reply e'er the consummated end come.

Is it really not enough for the inordinate rage of gain that hill and plain be dismantled tenfold to indefinitely beyond any needful present wants; but this boundless, nay, lawless cupidity, with instigations dire, must be doomed to invade all our high sources of prosperity; yea, run riot, if not wantonly mad—firebrand in hand before their perverted herds and flocks, up over our high forestal heritages, as we have seen unnumbered times, with ten thousand other citizens who can bear similar witness, if, indeed, any mountaineer of traveled age can be found on the Pacific who has not? It is with reluctance and the profoundest shame we are obliged to confess other people's sins, as well, but, thank heaven, we are not compelled, as yet, to confess that the whole remnant of the populace have fallen upon an utterly evil age emulous of personal and temporary gains regardless of consequences—that evil spirit which neither fears God nor regards man—present living men, nor their posterity. We are well aware the appellate motto of many leading minds is, "what has posterity done for us that we should care for them?" The stark effrontery of this looty sentiment could be seriously answered in the most burning and scathy fires of heaven's own glittering spears * * * but 'twere better left to slay its own offspring. Such a fearful first-born sentiment hath in itself ruin enough, yet let no one lay the flattering unction to his heart that this brazen lack-principle will cease from the ground of its own evil greed to flout in the face and eyes of a just and wise public policy legions of lies, high and low, subterfuges, fallacies, and frauds, with all the sophistical hordes begotten and born of it. Neither will it ever in anywise desist from its vicious vandalisms, were reasons offered high as heaven—staunch as the foundations of the world, and plenty as the best berries in June; therefore, for these and their following no one ever indites. But it would be one of the greatest wonders of the age if any sentiment so vile, so despicable, could be found as to have no public champion! nor do we flatter ourselves or the public that any array of statistics, historical observations at home or abroad, the world

over—explanations lucid in the light of ages, or focused as the sun of heaven, expostulations, exhortations, or threats will avail one iota. Therefore, *the time hath come for action*—the judgment of a just retribution, or due reimbursement by *law*—national and State, general and local, and if so be, the authority of these too are to become so bewebbed and wrested that there is no national, civil, or technical remedy to stay the sylvan cataclysm, then we appeal to the eternal bar of infinite, infallible, natural law that hasteth to summary execution by man's own loosened evils, for the fast times are upon us, shortening the days.

A word of reply is due the plausible plea for a negative "let alone" policy, *i. e.*, leaving trees to drift wholly in the tide of unregulated supply and demand, speciously urging that "more wood is springing up again than we have destroyed." This is true only to a limited extent in a few primitive cases where the prairie and the broken upland forest fires have been checked, or some half-open woodland intersections inclosed remote from the tramp of traffic, perhaps difficult of access and little pastured. Most of these and similar rejoinders do not bear investigation, and those that do only serve to confirm and illustrate accepted forestal experiences and established views, *e. g.*, meliorating bleakness, and so nearly or quite doubling the hardiest of all crops—grain. Examples from all parts of the world witness the axiom that no country can be healthy, wealthy, or in any permanent and proper sense prosperous, without a due and orderly proportion of woodlands. Without living wood for fuel, with facility of access, it is conceded every industry must languish, to say nothing of climate (of which we have already spoken; but too much can hardly be said on this point). Is it not remarkable that Norway, *e. g.*, can grow all our world-renowned conifers? Yet the frosts of the wine regions of Europe kills them! So true is it that any land once deforested and so deprived of its mean clime and aereal humidity, is made difficult or incapable of reproducing its own primeval or most desirable trees. The former state is only recovered by slow and orderly steps known, even though latitude, longitude, isothermals, thermometer, barometer, etc., offer no indication of change, yet becoming devastated and deserted more and moreover with a continual languishing; and to say nothing of health, or adequate food for subsistence, and all other considerations derivative; or what avails when the soil itself has fled and little but bare and barren rocky hills despoiled and left, mid and lowlands overlaid, fruitful vales deeply buried, richer bottoms spread with debris and sour silt, becoming a desert—outlying arid plains only waiting the drifting sands to complete the sad havoc. What signifies it, then, if a man did, on a transient time, get together a little *filthy* lucre by maternal pillage, is it any consolation to the wise and good to know that the spoiler migrated from the field of his self-imposed public ruin to work more mischief somewhere else?

NOTE.—At the outset it is due the public to say that the State Forestry Board have neither ways nor means provided for exchanges with similar bodies, foreign or domestic, upon any substantial and worthy basis—however hopeful we may be of the future—we feel ourselves under obligations to requite labor duly, or at least to reciprocate service for service. So far as mere plans and purposes respect one common end, ideal exchange is practicable; we trust by devotion to local conservation, and the collation of available information, with perhaps the contribution of some little original work, we may be fairly able to suggest a few such trees and shrubs as can be commended to the high consideration of our fellow citizens, so that with such aid as our selection from the ten thousands may afford, they may thereby be the better able to select their tithe also. To the intelligent and appreciative reader it is obvious enough that any explanatory catalogue from its very enumerative necessities must be brief; we have, however, seen fit to extend the limits somewhat in treating of trees and shrubs natives of our own country and coast, including a few foreign ones of more eminent promise of economic use.

Our own, with every other enlightened State of the age, is making earnest efforts to devise some means, however small the beginning, for the tests of botanic gardens, forest, and park reservation grounds, whereon the native sylva shall be cherished, and trials of foreign trees and shrubs can be made as well. Of late both the General Government and the States also, are manifesting the most enlightened statesmanship upon this and kindred subjects; already both the General Government and States seem duly coöperating to the same desirable end. With all honor and gratitude of their constituents, let us cherish the hope that in wisdom they may yet see fit to go on and reserve the most magnificent forest on the face of the globe. A portion of the Yosemite meadows also might well be devoted by us to Alpine and sub-Alpine species; these and private grounds ought to be munificently endowed; meanwhile, we must counsel together what are most promising for local culture and commendable to the intelligence of private culturists for their own trial, profit, or public spirited examples of more extensive industrial value. It is needless to dwell on the vast area of diversified soil and clime of this heaven-favored land, where, as it were, nothing comes amiss from the wide world, for it is all comprised in the ancient cognomen—*The New World.*

THE PINE FAMILY.

(*Coniferæ.*)

The pine trees, firs, junipers, cypresses, spruces, larches, yews, and Ginko Deodara, and several foreign trees, form a very natural group of the noblest, if not also the most useful timber trees of the globe—gigantic in size, for the most part, towering like palms in dignity, and, with but few exceptions, evergreens—in commerce known as "deal, fir, pine, spruce, cedar, redwood," etc. This most important order is principally found in the temperate climes of North America and from various parts of the world, in Europe, Siberia, and China, and some from arctic to the hottest regions of the Indian Isles. They yield largely resins, pitch, tar, turpentine oils, "Burgundy pitch" (of *Pinus Sylvestris*—similar of *A. Canadensis*), "Hungarian balsam" (of *P. Pumulis*), a fragrant incense resin (of *Arancaria brasilensis*), a "Copal" (of *Damara Australis*), "Strasburg turpentine" (*Abies* pectinata, *P. Picea L.*), "Bordeaux turpentine" (from *P. Pinaster*), "Canadian balsam," from *Abies balsamea* or the "Balm of Gilead fir," larch (*larix*) "Venetian turpentine," also a "manna" when dried, "Gummi Orenbergense," like gum arabic soluble in water, "Aliquid storax" (of *J. Communis* or *Callitris quadravalvis?*), besides very many other properties too numerous to mention here, but worthy, perhaps, of hints under particular species.

CONIFEROUS TREES.

GREAT WASHINGTON CEDAR (*Sequoia gigantea*).—The most colossal tree of the globe; between three hundred and four hundred feet high; diameter, thirty to forty feet, or more—*e. g.* at three hundred and fifty feet, eighteen feet through; age-limit unknown—many thousands of years; growth rapid, with great adaptability; a majestic and grandly graceful evergreen, conic in youth, aspiring in advancing age, and at length domed; wood light, soft, straight-grained, red, scarcely less lasting than the granite of the mountains upon which it grows, at an altitude of five thousand up to eight thousand four hundred feet. The timber has a wonderfully wide range of uses, but no disingenuous or stupid plea of "old, half rotten forests" can be urged for the reckless ruin of these trees of honor.

REDWOOD (*S. Sempervirens.*) An evergreen colossus of the Pacific Coast of California; only second to the mammoth cedar of the Sierra Nevada Mountains; two to three hundred feet, or more, high; fifteen to twenty feet in diameter; heart-wood of lower body heavy and lasting as the true cedar; wood, red, soft, free-grained, the upper parts light and brittle, like the big trees not troubled with insects, and equal range of use. But this

species only thrives in fogs. In our experience it pines when afar and away from its favorite sandstone or serpentine soil; attains to thousands of years—almost indefinite age—in cool or temperate humid coast haunts is of rapid growth. But it's the silliest of all vaunting to say "there will never be any scarcity of this timber in our country." The child is already born that's doomed to see the last of it—at the present rate of ruin—and yet live to no great age to speak of.

SOUTHERN *(Summer-green)* SWAMP OR BALD CYPRESS (*Taxodium distichum.)* A grand massive columnar tree of great value, one hundred to three hundred feet high, ten to fifteen, rarely twenty feet in diameter; wood, fine compact texture, durable; yields essential oil and superior turpentine; like larch and ginko the leaves fall off in Autumn; superior for swampy lands, avenues, or lakes, and river margins; of superior growth and very great age.* From Massachusetts to San Antonio, Texas.

California Incense Cedar (Libocedrus decurrens.) An elegant large tree, one hundred and fifty to two hundred feet high, four to eight feet in diameter; the arbor vitæ spray like "large honeycombs of green;" is even thrifty on dry hillsides; best at six thousand six hundred, but extends to eight thousand five hundred feet; kindly adaptable; wood, soft, light, stiff, dull creamy hue, very durable, like the world renowned cedars, holds spike and nail well, makes best of ties, boats, and all cedar uses in general, besides neat, sweet, odorless butter and fruit boxes, etc.; cinnamon bark rather thick, of spongy longitudinal fibers; grows rapidly and lives to great age.

Larix tetragona. A North Chilean species, of the Andes; two thousand to five thousand feet. Grows to one hundred and twenty feet, with a very straight stem. Wood quite white; highly esteemed for a variety of uses, nay, deemed most precious.

L. Chilensis. In cold valleys of southern Andes, Chili; two thousand to five thousand feet altitude. A fine tree, eighty feet. Resinous wood; hard; yellowish color.

L. Doniana. North island of New Zealand; up to six thousand feet. One hundred feet high, three or more diameter. Wood hard, resinous, dark red color, fine grained; makes excellent planks and spars.

JAPANESE UMBRELLA FIR *(Sciadopitys Verticillata).* A lofty and singular tree, one hundred and forty feet high; resists severe frosts. Wood white and compact.

YEW *(Taxus baccata).* Tree of middle and southern Europe and Asia, but generally only a shrub; up to four thousand feet. Wood yellow or brown; exceedingly tough, elastic, and durable—the joy of turners. The tree is of very slow growth; age to thousands of years; one of renown fifty feet girth.

FAR WESTERN, OR PACIFIC, YEW *(Taxus bravifolia).* Tree forty to seventy-five feet high, two to three feet in diameter; sap whitish, heart flesh colored; hard, tough, and elastic; cold coast creeks; to five thousand feet; rather slow growth.

CALIFORNIA MOCK-NUTMEG TREE *(Torreya Californica).* Best types one hundred feet high by four feet through; forty feet clear shaft, in redwood forests; easy to cultivate; free grower; tough and very durable timber.

CHINA MOCK-NUTMEG TREE *(T. grandis).* A tree sixty feet high, with umbrella-shaped crown; good timber.

* *Montezuma Cypress*—(*T. mucronatum.*) Far-famed forests of Mexico, one hundred and twenty feet high; about fifteen feet in diameter.

Japanese Mock-Nutmeg Tree *(T. nucifera).* Tree thirty feet high. From the nuts the Japanese press an oil for food. Nuts very astringent; probably the ones used by the Japanese interpreter *äd coercendam drinam,* if detained too long in the Imperial Council Chamber.

Florida Mock-Nutmeg Tree *(T. taxifolia).* Tree fifty feet high; wood firm, close grained, durable, reddish color.

Widdringtonia juniperoides. South African; three thousand to four thousand feet above sea level. A middle-sized tree, rich in resin.

The following allies of the Yew are unsurpassed for the uses of beauty, elasticity, durability, longevity, and, what is remarkable, rapidity of growth:

Nageia (Podocarpus) *cupressina.* (Chomorö) of Java and Phillipine Islands; one hundred and eighty feet high; one of their best timber trees.

N–a (P–s) *totara.* "Mahogany" Pine of New Zealand. Fine tree; one hundred and twenty feet high, six to seven feet through. Wood reddish, close grained, durable, valuable for building, furniture; extensively used as telegraph poles. Most useful timber of New Zealand.

N–a (P–s) *lamberti.* A stately tree of Brazil; most valuable timber.

N–a (P–s) *purdieana.* Of Jamacia; a quick growing tree to one hundred feet high; two thousand five hundred to three thousand five hundred feet above the sea.

N–a (P–s) *dacrydioides.* The "Kalikatea" of New Zealand Maories, "White Pine" of colonists; one hundred and fifty to two hundred feet, four to six through. The white, sweet fruit eaten by natives. Wood pale, close grained, and heavy, yet used for canoes; for swampy lands. Antiscorbutic beverage, like spruce beer, made of the twigs.*

N–a (P–s) *amara.* On the high volcanic mountains of Java; large tree, sometimes two hundred feet high.

N–a (P–s) *spicata.* "Black Rue Tree" of New Zealand; eighty feet high. Wood pale, soft, and durable.

N–a (P–s) *thunbergii.* "Gulhout" of Cape of Good Hope; splendid wood for building.

N–a (P–s) *Ferruginea.* The "Miro" (Black Pine) of northern New Zealand; eighty feet high; wood reddish color, very hard; its dark red resin bitter.

Among the fern foliage types of these trees are some of exceeding beauty and highest use, most of all suited to rural residences, and of rather rapid growth.

Ginko biloba L. (salisburia adiantifolia. Smith). Ginko tree, of China and Japan. A straight, colossal tree, of one hundred feet or more, ten to twelve feet in diameter; summer-green foliage, of fan form, like the maiden-hair fern, of great elegance and beauty; fruit size of damson plums; by Japanese, seeds esteemed for promoting digestion; wood white, soft, easy to work, and takes most beautiful polish. The edible seeds when pressed yield a good oil. It is estimated that the tree attains to three thousand years of age; of easy culture; flourishes very well here.

Phyllocladus rhomboidalis—Celery Pine of Tasmania. A stately tree up to sixty feet, two to three feet in diameter; ship-mast timber; grows only to advantage in deep, sheltered valleys in crowded forests.

Podocarpus trichomanoides—Celery Pine of New Zealand, northern island; also called "Pitch Pine;" tree seventy feet high, of straight stem, three feet diameter; pale, close-grained timber for ship planks, spars, etc. Maories dye red and black from the bark.

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* Probably *Dacrydium taxifolium* is this same tree.

Fitzroya Patagonica. A stately tree, closely allied to the arbor vitæs, over one hundred feet by fourteen; the wood red; all but imperishable in open air or underground; does not warp; is easy to split; great variety of uses besides coopers' and carpenters' work; the bark yields strong fiber for caulking ships, etc.; like most trees of very cold regions, requires planting in the mountain forest.

SALT MARSH SHRUB (S.W. Australian *Actinostrobus Pyramidalis*—Mig.); *Frenela Actinostrobus*—Muell. Although only a shrub, placed here because so desirable for planting on coast and bay salt marshes, as well as our alkaline desert flats, where other conifers do not readily succeed.

Frenela Verrucosa. Useful tree for binding coast sand, as also drifting desert lands of the interior.

F–a Maclayana. New South Wales. A handsome tree, of regular pyramidal growth to the height of seventy feet; timber valuable.

MONTEREY, OR LARGE-FRUITED CYPRESS. (*Cupressus Macrocarpa.*) Magnificent shade and shelter tree of bleak coasts, sixty to one hundred feet high, nine in diameter; the quickest growing conifer known, except (Pinus insignis), "Monterey Pine," P. radiata; even thriving fairly in poor, dry soils.

LAWSON'S CYPRESS, *Chamœcyparis Lawsoniana* (*Cupressus Lawsoniana*)—Murr. North California. From one hundred to one hundred and fifty feet high, two to six feet diameter; handsomest of all the cypresses; wood white or slightly cream-tinted; soft, fragrant, elastic, durable, clear, and easily worked; great adaptability to situation under culture; grows freely.

Dacrydium cupressinum. Native "*Rimii.*" Red pine of the colonists of New Zealand; stately tree; two hundred feet; wood hard and valuable; eligible for forest valleys; suitable for cemeteries, on account of its pendulous branches.

Dacrydium franklini. The "Huon Pine" of Tasmania, found only in moist forest recesses; suited to similar cañons here; one hundred feet; five to seven feet in diameter; wood highly esteemed for ship building and various artisans' work.

(*Cupressus nutkaensis*) *Chamœcyparis Nutkaensis*—Spach. "YELLOW CEDAR" of Alaska; tree one hundred feet high; wood yellowish light; fragrant, strong, and exceedingly durable in the most trying exposures; superior for boat and ship building; bast for mats and ropes; suited to cold, wet coasts, from California to Alaska.

C–s benthami—MEXICAN CYPRESS. Five thousand to seven thousand feet. A beautiful tree, sixty feet high; wood fine-grained, and exceedingly durable.

C–s lindleyi. Mountains of Mexico; a stately cypress to one hundred and seventy feet high; timber excellent.

C–s obtusa, of F. von Muell (Retinspora obtusa—S. and Z.) Japan. Tree eighty feet by one to two; forms the great part of the forests at Nipon; wood white veined and compact; when planed of a beautiful silky luster; their temples made of it—N. B. Some varieties with golden, others silvery foliage. Two other very graceful cypresses of Japan are worthy of introduction, to wit:

C–s breviramea. (Chamœcyparis breviramea, Maxim;) and

C–s pendens. (Chamœcyparis pendula, Maxim.)

C–s pisifera—F. von Muell. (Chamœcyparis pisifera—S. and Z.) Japan; tree thirty feet; ornamental; variety of golden foliage.

C–s sempervirens; the COMMON CYPRESS OF SOUTH OF EUROPE. Tree to eighty feet, and famous for great age and durability of timber; next to

imperishable; much sought after for the manufacture of musical instruments.

C–s thurifera of Mexico. Three thousand to four thousand five hundred feet above sea. A handsome pyramidal tree upwards of forty feet.

C–s thuyoides (Chamœcyparis Sphœroidea—Spach.) This is the WHITE CEDAR of cedar swamps of Eastern United States, in low moist morasses. Tree eighty feet tall by three feet in diameter. Wood light, soft, fragrant, fine grained, and very durable, famous fencing, for shipping, boats, shingles, and wooden vessels, and no end to manufacturing and art uses. Suited to lands undrainable and of no other use—easiest of all forest culture. Seed sown in Autumn broadcast on ground or water surface. Seed here germinates in a few months—at East often requires six to eighteen months. Wood though white when cut, turns faint rose-red by exposure.

C–s torulosa. The NEPAL CYPRESS of North India, four thousand to eight thousand feet above the sea; tree one hundred and fifty feet by five feet in diameter; the reddish wood fragrant, and durable as the Deodar cedar; highly valued for furniture, etc.; prefers *limestone* soil.

C–s McNabiana. MCNAB CYPRESS of California Coast; a tree of moderate proportions, ten to thirty feet by foot or more; foliage in somewhat flattened fan-spray, soft glaucous hue, pyramidal form; a very handsome tree, suited to the foregrounds of landscapes. and limited lawns, and needs no pruning. Timber excellent; of rather rapid growth.

C–s goveniana, or DWARF CYPRESS of California. Tiny tree, three to ten feet; in ample fruit bearing at three feet; dense upright growth; seed deep purple to jet black; very pretty for limited localities.

C–s guadalupensis. This ISLAND CYPRESS, thirty to forty feet high, two to five feet in diameter; sheds its bark, leaving smooth surface of claret-red; valuable for timber and for ornament for coasts near sea level; like most cypresses, thrives in rocky relatively barren soils.

Dammara alba. Rumph. (D. orientalis. Lamb).—Agath Dammar. Indian Archipelagus and main land. A large tree, one hundred feet high, trunk eight in diameter; straight and branchless two thirds. Of very great importance; yields the famous transparent Dammar resin, extensively used for varnish.

D–a Australis. Lamb.—"KAURI PINE." North Islands of New Zealand. A magnificent tree, at least one hundred and eighty feet and seventeen inches in diameter; seven hundred to one thousand in age; excellent timber for masts, furniture, and almost every other purpose, besides the Kauri resin of trade.

D–a macrophylla. Santa Cruz Archipelagus. A beautiful tree of one hundred feet, like *D–a alba.*

D–a moorei. New Caledonia—fifty feet.

D–a obtusa. New Hebrides. A fine tree, one hundred feet high, long clear trunk, like *D–a australis.*

D–a avata. New Caledonia, rich Dammar resin.

D–a vitiensis. In Fiji, tree one hundred feet high.

SUGAR PINE OF CALIFORNIA—*Pinus lambertiana.* Elegant tree at all ages; cones, a foot to one and a half long, pending from the tips of long spreading or slightly depending branches—one to four together; two hundred and fifty feet high by twelve in diameter; lumber, soft, not so white as *P. strobus;* leaves, in fives, of nearly equally fine needles, and feathery; altitude, nine thousand feet; does not seem to flourish well below three thousand; timber, exceedingly valuable for a thousand purposes; wood, heavier and stronger, otherwise closely allied to the white pine.

Pinus Monticola—M. AND WEYMOUTH, OR PACIFIC WHITE PINE. A tree

of the *Strobus* section of pines—Pacific analogue of N.E. *White pine;* resembles the preceding, on a smaller scale; habit and foliage, similar; wood, white, soft, and valuable; from eighty to one hundred feet high by three to six feet through; altitude, seven to ten thousand feet above the sea; California and Oregon. These cones, although a little larger, greatly resemble the following. A dwarf variety, fruiting at three feet; tiny cones, madder-purple.

Pinus Strobus—THE GREAT WHITE (WEYMOUTH) PINE OF NORTH AMERICA. A stately tree of supereminent beauty, one hundred and fifty to two hundred and fifty feet high, five to eight feet in diameter; of rapid growth; flourishes well on poor sandy soils mainly; most thrifty on a moist sandy loam; rarely in rocky, half swampy soils; very adaptive to a variety of soils and conditions corresponding to the temperature of Northern United States and Canada, even extending to latitude fifty-four north. The wood is very light (next to poplar), soft, and durable; has a wonderful wide range of uses, but lacks strength; so remarkably free from knots, it is greatly preferred for masts; fitted for all finishing and inside work, as it easily polishes to the greatest beauty; takes painting and gilding in a remarkable degree; choice wood also for the carver. The long, soft, plumy tufts of lively blue-green leaves extend so far back makes it one of the most effective, mildest tempering pines for shelter-belt against fierce, harsh wintry winds, even when very young, and for this purpose alone is immensely valuable.

Pinus flexilis—LIMBER TWIG PINE. A sub-alpine tree eighty to one hundred and twenty feet high, three to five through; at an elevation of about nine thousand feet; of rapid growth; conic symmetrical shape; foliage somewhat similar to white pine; wood coarser, harder, and stronger—miners speak well of it, but their tests are too recent to warrant any reliable word of its durability. We think likely to flourish well throughout the temperate parts of the Pacific; cones elongated, egg-form, three to four inches; scales thin and, like the bark of the body, gray, this latter only moderately rough, being rather slightly creviced. In every manifest respect unlike the following very distinct species.

P-s albicaulis—CLARK'S CROW or GRAY JAY PINE. Along the highest timber-line margin of the Sierra Nevada Mountains of Mono to Shasta, and from the Rocky Mountains and New Mexico north to British Columbia and Montana, at ten thousand to twelve thousand feet, from these heights of depressed prostrate shrubbery it becomes forty to fifty feet high by one to two feet diameter where less buffeted by wintry storms. The trunk-bark thick, deeply cleft, and coarsely gaping, of a clean, lively, cinnamon-brown color, branches and twigs mostly whitish, hence specific name; cones common egg-form and size, purple to madder-brown; scales thick, smooth, and shining, dull pointed; small edible seeds, apparently wingless, the choice food of Clark's crow; wood yellowish, tough, and durable. As the sap in living cones, when bruised, turns to a rich violet hue, it would doubtless yield a splendid violet dye.

P-s balfouriana—PANTHER-TAIL PINE. Tree of moderate size, fifty to eighty feet by two to four in diameter, of regular pyramidal growth—rarely the lower branches in age depending—long, slender terminal twigs with short, rather close pressed, very dark green leaf needles in fives, extending far back from the tops, *i. e.*, persisting ten to fifteen years, hence they impress one with the peculiar fir or spruce likeness after the similitude of *panthers' tails*, hence the common name; cones subcylindric, about four inches long, thinnish scales, outer disk margins swelled, central prickles early falling off; seeds pale mottled and winged to six or eight lines in

length, widest in the middle; this forest forms a very dark green, almost black, belt nine thousand to eleven thousand feet above sea level; quality of timber not yet fairly tested; bark of the body thick, dark reddish brown, coarsely open fissured.

Variety *aristata*, we have not seen. Tree fifty to one hundred feet high; cones with less elevated disk than the above; egg-shaped, and every way more like *flexilis*, with sharp, slender, awn-like prickles; found in Colorado, Rocky Mountains, Inyo Mountains.

P–s torreyana—TORREY PINE. A low coast pine, thirty to forty feet, by one to two thick, broadly branching, more or less awry by buffeting winds; the straw leaves, stoutest of any known pine; aspergiled at the ends of stout twigs, in boots of fives; cones rather large, about four by four and a half inches; old straw beehive-shape, and no hooks to the scale-disk; half-close, color dull madder-purplish; short wing inclosing the large edible seed with a very thick rim, readily falling away. Southern California, between San Diego and San Pedro. Timber reputed good, but scarce.

P–s sabiniana—SABIN'S NUT PINE. This "Gray Pine" belongs to the hot and dry foothills, mainly of the middle rolling lands and Coast Ranges of California; rarely over fifty to seventy-five feet high, about two to three feet in diameter, roughish ash-gray bark; leaves in threes, eight to ten inches long, light, thin, gauzy; tops of tree open-forked, or branched like the more common deciduous trees, and hence, moderately rounded head, yet the glaucous, smoky-green verdure, like a lady's vail that hides not the beauty beyond, so neither this the landscape; hence, a famous foreground tree; gives depth without obstruction, and lets fall a soothing softness over the scene. Cones deciduous, massive, six to ten by four to six, and clustered; very large nuts edible; wood white and soft, but not brittle; of quick growth in dry localities; found from near sea level up to three thousand or four thousand feet elevation.

P–s coulteri—THE GREAT CONE COULTER PINE. A broadly branching conifer of magnanimous aspect, dome-topped, lightish gray-green tint, the very long and large clay colored close-cones persistent. Seeds black; much smaller than the Sabine pine, while the wings are five or six times longer. Cones oblong (ten to twelve inches); scales like grizzly's claws; leaves in long needles nearly a foot in length and rather rigid. Well adapted for a sixty to seventy foot middle-ground tree. Three thousand to four thousand feet. A tree of rapid growth on dry coast hills and vales; body dark. The wood said to be brittle; but of this we have no knowledge.

P–s insignis (radiata)—MONTEREY PINE. A handsome seashore or Pacific pine, eighty to one hundred feet high, two to four feet thick; of remarkably rapid growth, even on these drifting sands, which it tends greatly to fasten; also forms excellent shelter belts against the fierce repressive blast that either kills or cripples nearly all culture. Sown broadcast and uncared for, only a few years serve to establish notable groves—in youth yielding to storm, yet wont to right itself up again whenever the wind lulls. Wood tough and of good repute; needle leaves, in fours and fives, three to five inches long; the brown varnished cones, clustered, bent forcibly back against the branch, obliquely swelled outward at base, where it is strongly knobbed; otherwise, in outline short ovoid, point incurved; three to five inches long by two to three thick. The cone remains on and closed many years; seeds black and rough.

P–s Haleppensis—ALEPPO PINE. Tree eighty by five feet; young timber white, old dark; for ships and furniture. Yields Venetian turpentine and tar. Thrives well in waterless, rocky places, and on sandy seacoasts.

P. maritima is a variety of this species. Content with the poorest and driest localities, and of rapid growth.

P-s pinaster—CLUSTER PINE. Like the preceding, on the shores of the Mediterranean. Tree of quick growth; rises to sixty feet. Wood soft and resinous; yields largely the French turpentine. Among the best for consolidating coast lands and converting rolling lands into pasture and agricultural soil. For easy rearing and rapidity of growth, one of the most important of all pines.

P-s pinea—STONE PINE. Bordering as above. Sixty feet. Wood light, white, and full of resin; for ships, buildings, and furniture. Cone similar to *insignis*. Seeds edible; ripen only in their third year. This pine grows as easily and almost as quickly as the cluster pine.

P-s pinceana—WEEPING PINE. Of Mexico; up to nine thousand feet above the sea. A very remarkable pine, of drooping branches like the weeping willow, sixty feet high. Most desirable for shelter curtains, for cemeteries, and for ornament.

P-s Pseudo-strobus—THE MOCK-WEYMOUTH OF MEXICO. The most elegant of any Mexican pine; eighty feet high.

P-s pyrenaica—PYRANEES PINE. South of Spain, on the Pyrenees. A fine ornamental tree, of quick growth; eighty feet high. Wood white and dry; free from resin.

P-s excelsa—LOFTY, OR BOOTAN PINE; Asiatic "WEEPING PINE;" LUMSHIRE," and at *Nepal*, "CHYLLA." A tree forming large forests of Himalaya Mountains, six to eleven thousand feet. A very fine pine, one hundred and fifty feet high. A valuable white, close-grained, durable, resinous wood, besides furnishing a good quantity of turpentine; branches white; growth rapid under care of Mr. Klee, at the State University grounds.

P-s Canariensis—"CANARY PINE." Canary Islands; forming large forests at five or six thousand feet; seventy feet high; resinous, durable, very heavy wood, not readily attacked by insects; branches in whirls; manifests great celerity of growth.

P-s Longifolia—Emodi, or CHEER PINE. Himalaya Mountains, two to seven thousand feet. Handsome tree, branchless; stem fifty feet; wood resinous, red variety; useful for buildings; yields a quantity of tar and turpentine; stands exposure and heat well.

P-s Larico—CORSICAN PINE. Southern Europe; one hundred and twenty feet; wood white; near the center, dark; very resinous, coarse-grained, elastic, and durable; esteemed for building, especially waterworks; three main varieties—*poiritiana*, in Italy; *austriaca*, in Austria; *pallassiana*, of Black Sea; grows best in chalky soils, and in poor sandy soils, where, however, the timber is smaller and not so good; yields all the products of *P. sylvestris*, but in greater quantities; perhaps the most resinous of all pines.

P-s muricata—BISHOP'S PRICKLY-CONE PINE. Of the Pacific Coast; tallest in peaty bogs; seeks sandy seashore, and found up to two thousand five hundred feet above; often a moderate sized tree, of twenty-five to fifty; rarely over one hundred feet high; slender; one to three feet thick; bark, reddish brown; needle leaves, in pairs, four or five inches long, often very slender; cones close set in spreading whirled clusters of four to seven, rarely ten or more, egg form, somewhat one-sided, with a down curved point, about three by two and a half; color brown, close, and persisting many years; central prickles of the scale-disks sharp; in the exposed southern coast form, strongly knobbed and spurred; the recent wood exhales the odor of apples.

P-s parryana—"PARRY'S PINE." Near the southern boundary line of California. A symmetrical compact conic *nut pine* of small stature, fifteen

to thirty feet high, ten to eighteen inches in diameter; leaves in bootees of three to five, usually four, of softened glaucous sheen; unsurpassed as an avenue tree. These and like trees lay quieting hand upon the natural dust by the wayside, or sandstorms of the desert, saying to the troubled elements, "*Peace!* be still." Common to low altitude, two thousand to three thousand feet.

P–s parviflora.—"GOYONOMASU," Japanese name. Small pine twenty-five feet high by one; much used for an avenue tree; wood fine for furniture and boat-building.

P–s monophylla—ONE–LEAFED NUT PINE. Of California, up to about six thousand, mostly on the eastern slope of Sierra Nevada Mountains, in the most arid localities, fifteen to forty feet high; usually low, rounded, scrubby outline; foliage, gray-green. Cones subglobose of few scales, with large blunt knobs, apparently wingless seeds, a most important article of food to the Indians.

P–s massoniana (Sinensis)—of China and Japan. Tree of sixty feet; supplies resinous, tough, and durable wood for buildings and for furniture; roots burned with oil of *Brassica Orientalis* furnish the Chinese lampblack, in cakes, for stenciling, etc.

P–s mitis—YELLOW PINE, SPRUCE OR SHORT–BOWED PINE. In dry sandy soil; sixty feet. Wood durable, resinous, valuable flooring. United States.

P–s hudsonica (Banksiam)—GRAY PINE. America, north to sixty-four degrees; to forty feet. Wood light, tough, yet easily worked.

P–s patula. Mexico, eight thousand to nine thousand feet; a graceful pine eighty feet high.

P–s ponderosa—HEAVY YELLOW PINE. . Of Northwest America. From one to two hundred feet high, by four to eight in diameter, of comparatively quick growth; wood heavy, and for general purposes, preferred to other pines. Although found from three to six thousand feet, it is also well adapted to lower levels—strong, thrifty, hardy, and most generally distributed—does well on dry sandy soils.

P–s regida—PITCH PINE. Of Northeast United States and Canada. A conifer of deep dark green foliage and picturesque form and beauty; flourishes on poor, dry, gravelly, or rocky and barren hills, rolling sand plains, even down into the saline soils of spring-tide overflows; hence, adapted to unproductive and valueless shores, as well as dunes dangerous to contiguous fields, cities, and villages; in short, all places in lee of drifting sands, and is, indeed, a most excellent, rigid nurse and shelter for tender fruit and deciduous trees. A belt of white pine, backed by a belt of these to windward, would say unto the raging storms, "Peace! be still." Subdued, it would sigh and sing along the gale some sweet seremade of joys present or parting, pleasant and mournful to the soul. This is a tree all the way from nearly a shrub to one hundred feet high, by a few feet in diameter; bark black and excessively rough; needle-leaves in bootees of threes crowded or brushed on the tips of crooked upturned twigs; scales of cones sharp. Wood bright wine color, resinous, hard, strong, and durable, especially for ships, wheelwrights, floors, flumes, etc.; yields abundant turpentine, resin, pitch, and tar.

P–s resinosa—RED PINE. A tree forty to one hundred feet high, two to four feet in diameter, tall and slender, free below, bark in broad, smooth scales of reddish color; branches in distinct whorls, horizontal, at length declining, and upcurving to a line of beauty at the tips conspicuously bottle-brushed, with the long leaves in twos; a handsome object on the landscape; cones often clustered, two to four, egg-shaped, two inches or more at the end of the year; ripen at the end of the second season; wood reddish, fine

grained, rather soft, durable, and strong, free from much resin, and of quality between white and pitch pine, and grows as rapidly.

P–s serotina—POND PINE. Of United States, south; in black, morassy soil, mostly near the seacoast; fifty feet high, one to two thick; wood soft.

P–s tæda—LOBLOLLY PINE. The "*old field pine*" of the south United States, in poor, worn out, sandy soil; fifty to eighty feet; fine for inside work; quick growth.

P–s tenuifolia—THREAD-LEAF PINE. Mexico; elevation of five thousand feet; forms dense forests; to one hundred feet tall and five feet in diameter.

P–s teocote—"*Okote*" or TORCH PINE. Mexico; five to eight thousand above the sea; tree one hundred feet high by three to four; wood resinous and durable.

P–s tuberculata—KNOBBY PINE. One of the best Pacific Coast shelter pines; if much exposed, on poor, dry soils, is only a small conic tree, but inland, or in deep, secluded ravines, it rises to over one hundred feet high, and very handsome. Needle leaves in threes, four to six inches long, near a line broad. Cones hold on a whole generation, whirled around body and branches in circles of three to six or so, and strongly bent back against them, about five or six inches long by two thick, of conico-cylindric form, its sharp point incurved, outside obliquely swelled, and their back strongly knobbed, these subspurred or tuberculated scales, prickly top, a clay-colored close cone. Like most coast pines, of remarkably quick growth, only a little less than *P. insignis*, up to two thousand five hundred.

P–s abies (P. picea L.)—SILVER FIR. Of Middle Europe, to fifty degrees north latitude, in dense forests; a fine tree; charm of the ancients; two hundred feet by seven; grows to three hundred years of age; most valuable building timber, and from its lightness, toughness, and elasticity suited for furniture; yields a fine white resin, and the Strassburg turpentine, similar to Venetian.

P–s australis—SOUTHERN LONG-LEAF PINE. Of United States, North America; seventy to one hundred feet; the principal tree of the pine-barrens, whence our tar and turpentine and great pine supply of timber for building and extensive uses; poor, sandy, dry soils, loams, and swamps; a very adaptable tree.

The few following firs of the great PINE FAMILY are the most lovely and the loftiest trees known. For regularity, symmetry, and a due degree of elegance, combined with dignity and grandeur, few sylvan objects equal them. They are readily distinguished by their smooth bark, often blistered, and table-tiered whorls of branches; leaves very short, single, and pine-like, seemingly set in two rows, extending very far back, leaving circular scars, and falling off, but not propped up on elevated bases, like spruces. Most conspicuously of all, discriminated by the *cones standing up erect, like birds upon the topmost boughs.* * * * Other marks might be mentioned, but here deemed best to omit.

Abies (Picea) *nobilis*—NOBLE SILVER FIR. Of the Pacific West; truly a noble sylvan type of highest humanity; on mountains six thousand to eight thousand feet above sea level; sometimes seen two hundred and fifty feet high by four or five in diameter; the upturned foliage in perfectly level platforms of circling spray, successively lessening to the summit, silvery-sheened, and, as it were, velvet-lined verdure of amazing beauty, stateliness, and perfection; bark, cinnamon brown; cones oblong, six to eight inches, and about half as thick; broad bracts fringed and pointed, much protruding, and bent back so as nearly to cover the scales; timber known as "red fir," and best quality of the section, if we except *A. concolor.* Mount Shasta, locality in California.

A–s magnifica (Picea *amabalis*)—MAGNIFICENT SILVER FIR. Of the Sierra Nevada Mountains of California; from seven thousand to ten thousand or eleven thousand feet; for loveliness and for towering grandeur this tree is unsurpassed in dignified port, like the *nobilis*, of which it may yet be considered only a variety (?). It grows to two hundred and fifty feet by five or six; sprays in similar sections of circles, silver-lined, and forms very dense fans of upwardly curving foliage, peculiar to most Alpine firs; bark reddish; cones very large, six to eight by three to four or more inches. Altitude eight thousand to nine thousand feet. This "red fir" timber, exposed to the seasons, seems too readily perishable. Yet some accord it the highest repute among firs.

A–s grandis (Picea)—THE GRAND SILVER FIR. Of the Pacific Coast of North America. This very lofty species is two hundred to three hundred feet high by about four feet in diameter; bark rather even and brownish; wood white, soft, and coarse; in the southern form, leaves more distinctly two-rowed, bright varnished green above, two silvery lines below; sparser, hence a more light and airy head; var. *densifolia* is the same, only clad in a thicker Winter dress, suited to a more northern clime, just as we see in similar evergreens, too numerous to mention; cones cylindric, apex depressed-naveled, two to four inches long, by about one and one half inches thick; bracts hidden within; seeds with a very oblique wing, about as long as broad.

A–s (Picea) *concolor*—WHITE SILVER FIR. Of the Sierra Mountains of California; found from southern Rocky Mountains of Pike's Peak, Colorado, into valleys and foothills of New Mexico and Utah, etc., at about three thousand to seven thousand feet; the best quality of timber, exceedingly stiff, tough, strong, and durable, the farther west and on northwest exposures.

A superb *Silver Fir*, readily distinguished from its congeners by the softened pale, sea-green foliage; also the bark of the top parts being white, fading to whitish, and thence lower to ash-gray of the old fissured portion toward the base; besides it is notable that the leaves are longer than any other of our firs, when young two to three inches, although on old trees short, lower ones more apt to be notched, and, as usual with true firs, much bent up and crowding the foliage points upon the upper surface of the twigs, thus forcing them into a sickle-shape; near these upright cones, rounded on the back and always blunt pointed on flowering branches, keeled above and almost quadrangular, the scales are much bent up, so that a cone broken off shows the lower half deeply cupped, hence the seed-wing has also a strong lateral flexion. Nothing equals this timber for those enormous deep-mine pump-rods; also, being odorless and tasteless, it has no superior for butter and the like boxes, nor for wine casks, and for paper pulp, etc.; one hundred to two hundred feet high, by four to six.

A–s (Picea) *bracteata*—FRINGE-CONE FIR. Of Southern California Coast Mountains, Santa Lucia only; an elegant steeple-shaped feminine Silver Fir, unsurpassed in aspiring beauty, combining all the merits the most critical amateur could desire; one hundred and twenty to one hundred and fifty by two to four feet; leaves like our Mock Nutmeg (*Torreya*); *i. e.*, long (two to three inches), line-like and sharply lance-pointed, of stiff and strong texture, in two rows—much more manifestly than other Firs; bracts scarcely longer than the *smooth* scales, but its mid-rib awny prolongation extends far out of the cone one to one and one-half inches, clothing the whole surface, as it were; fringed with recurving slender leafy awns. The upper smooth bark blistered with balsam crypts; cones egg-shaped, about

four by two and one half inches; three to six thousand feet above, and close to and overlooking the Pacific shore; timber elastic and very tough.

A–s (Picea) *Fraseri*—DOUBLE BALSAM or FRASER FIR. At six thousand feet, on the mountains of North Carolina; a small tree, thirty to forty feet by a foot or so; bark smooth, cinnamon-brown; distinguished from the *Balsam Fir*, Balm of Gilead species, by the short and more oval cone, and very much protruding bracts between the scales, and bent back over them. This very handsome and deliciously fragrant little wintergreen tree, together with the following, yield the Canada Balsam used in the arts and in medicine; also found on the Broad Mountains of Pennsylvania, Saddle-back Mountain, Massachusetts; Green Mountains, Vermont; and Mount Washington, New Hampshire.

A–s (Pinus or Picea) *religiosa*—OYAMEL FIR. Mexico to Guatemala, four thousand to nine thousand feet above the sea. A magnificent silvery fir, but the upper surface of foliage dark and glossy; cones oval oblong, three to five inches by one and one half to two inches thick; bracts more or less protruding between the scales and sharp pointed; these scales one third wider than high, and seed wings longer than wide. Fir one hundred feet high by six; wood superior for shingles.

A–s (Picea) *balsamea*—BALSAM FIR. *Balm of Gilead Fir.* Extends from Canada and Northeast United States to mountains of Virginia, and beyond Mississippi River; larger tree than the *Fraser double fir*, seventy by one and one half feet; bark smooth and reddish gray when young, brown and cracked with age. The slender cones with the bracts inclosed (or barely the points rarely out) yields the *Canada balsam*, an excellent oleo-resin; a preparation of this used as a varnish for water colors, also for mounting delicate specimens for the microscope; the timber is light, soft, and suited to furniture; thrives best in a cold Alpine morass or mountain meadows, where it is of quick growth and admirable beauty while young, short lived, rough and ragged with age.

A–s (P.) *cilicica*—CILICIAN SILVER FIR. Of Asia Minor; four thousand to six thousand five hundred feet elevation; beautiful tree of pyramidal growth, one hundred and sixty feet high; wood very soft, used extensively for roofs, as it does not warp; more properly a spruce.

A–s (P.) *nordmanniana*, several varieties. This of Crimea and Circassia, six thousand feet above the sea, is one of the most imposing silver firs; one hundred feet of perfectly straight stem or body, and yields valuable building timber.

Abies (Picea, P–s) *orientalis*—SAPINDUS FIR. Of Asia Minor; four thousand feet, eighty feet high, like the Norway spruce. The wood is exceedingly tough and durable.

A–s (Picea or Pinus) *picea*—NORWAY SPRUCE. Middle and Northern Europe and North Asia; rising from the plains to an elevation of four thousand five hundred feet, forming extensive forests; tree one hundred and fifty feet high or more; furnishes excellent timber for building and furniture; commonly known as *white deal*; yields Burgundy pitch in quantity, while the bark is used in tanning. Admirably suited to our cold, moist, foggy coast range, as also higher damp mountain ranges of the interior, and of Oregon more generally.

SPRUCE.

Picea (Abies.)

Distinguished from *Pines* by their steepled top and fine leaves, very short, solitary—usually appearing two-ranked—and always set up and jointed on to a little prominent thready-decurring-persistent base; relatively small cones, terminal and pendent on the tips of last year's twigs; scales looser, thinner, sub-membranous, maturing the same year and falling off entire, *i. e.*, not breaking to pieces like *Firs*, that leave the spindle-axis still perched on the top of their trees; nor do *Spruces* leave any *circular* scars of fallen leaves, theirs being rhombic; the seeds have no minute resin-vesicles on the surface, etc.

P–a Sitkensis (Abies—Pinus)—SITKA SPRUCE. A tall steeple-top tree, one hundred and fifty to two hundred feet high, three to nine feet in diameter, then rather flaky red-brown bark, very tough timber; cones, cylindric-oval, two to three inches long, less than an inch broad; finger-nail-like scales, loose, crimped, and finely toothed on the margin. In very enriched soils of old Indian lodges, beautifully and very long pendent curtain cord spray, producing the variety *pendula*, suggested by authors. It seems impossible to find a climate too rainy, or a soil too wet, if above the stagnant limit and below perpetual frost. From near the sea level to three or four thousand feet.

P–a (Abies) *nigra*—BLACK SPRUCE. Distinguished from the *White* by the darker, denser foliage, greater relative thickness of cone, and the loose scales being jagged on the edge; and from the *Hemlock*, by the leaves being equally distributed on all sides of the twigs; and the *Hemlock Spruce*, from both, moreover, by its very tiny cones. A tree forty to eighty feet, or even one hundred, by one to three thick; trunk, straight, uniformly tapering from ground to top; even bark, often whirl-branched; little, short leaves, four-sided and blunt; cones, egg-shaped, one inch or so long, lying point down; thin scales, wavy-crimped, and notched or toothed margin; ripe late into Winter; timber, white or reddish, famous for lightness, strength, elasticity, and durability, is even tougher than the *White*—famed for spars and ladders, being stiff—and unnumbered shipping and mechanical uses. *Spruce beer* from the twigs. Thrives well, even in dry soils, but prefers the swamp; is ornamental.

P–a (Abies) *alba*—WHITE SPRUCE. This is a very slim and wiry spruce of Northeastern United States, as seen densely groved in swamps—otherwise deemed worthless—rises forty to fifty feet or seventy-five, straight as an arrow; bark even and light brown; foliage bright, cheerful bluish-green, equally set up all around the twigs; cones variable to three inches, the thin, vellum-like close scales with smooth, entire margins; timber light, elastic, tough, and durable; young and tender sprigs used for making beer, and the tough roots used as cords and threads by the Indians. Seen by us as far north as latitude 60° in Alaska, also extends 7° or 8° further. Seeds sown broadcast in the Fall over swamps succeed well.

P–a (Abies, Pinus) *firma*—JAPANESE SPRUCE. A lofty pyramidally aspiring evergreen of nearly whirled boughs, lower horizontal branchlets subopposite; leaves straight or slightly upcurved, notched at the tips; cones pendent, cylindric-obtuse, five inches by one and one half broad, straight, or subcurved; thin membranoid scales, kidney-form, irregularly toothed on the rounded margin. Region of Lower Japan, one thousand eight hundred to two thousand feet altitude.

HEMLOCK SPRUCE.

*Tsuga—*Abies *Section.*

Tsuga (Abies.) Leaves petioled with very short, thready leaf-stemlets, jointed to a prominent, persistent, decurring base, which renders the twigs very rough when they fall away. Seeds with tiny vesicles.

Tsuga (Abies) *Mertensiana*—MERTEN'S PACIFIC HEMLOCK. In flourishing forms of the North Pacific Coast the very dense foliage of the hairy twiglets so crowd and confuse as almost to conceal its naturally two-rowed character; but in the milder climate of the North Coast of California it is a neat, delicate, airy, and gauzy beauty beyond description; most distinctly two-rowed, as it were, a spirit-tree, soft and ethereal as the haze of an Indian Summer. Tree one hundred to two hundred feet high by three to six; spiry top, horizontal slender limbs of graceful, cheerful, feminine reach, and upward sweep, or in age the gentle pending spray a little prone and picturesque; unsurpassed as a serene shelter-belt against damp, cold, bleak exposures; bark thick in age, and rough reddish-brown, live coating purple; wood whitish, strong-grained, and stiff, not very durable except as inside lumber; bark useful for tanning; cones similar to eastern; will almost grow on a bare rock with ceaseless rain and sweet moisture; if in comparatively dry soils we notice the roots still reach living water. Found up to two thousand feet or more. *Young and very thrifty timber;* is lasting. Civil Engineer Roberts says: "Railroad mudsills of small size (sound sticks) will last as long as white pine."

T–a (Abies) *Canadensis*—HEMLOCK SPRUCE. Common to Northeastern United States and Canada, mostly on hills and mountains; a very ornamental tree, excellent shade and shelter, one hundred feet high, wood whitish, coarse, and cross-grained, inferior save as sheeting and inside rough wood; bark very valuable for tanning, stripped off in Summer, spruce beer made of young shoots; the younger the tree the better the timber; among the handsomest evergreens of North America; no Winter shelter tree exceeds it.

T–a (Abies) *dumosa*—TANG SING. Boutan (Bootan) Himalaya region, eight thousand to ten thousand feet—S. K. Kim's "SILLOO HATARHEE" of Nepal; a very ornamental spruce, seventy to eighty feet.

T–a (Abies) *fortunei*. China, near Foo-Chow-foo; a splendid tree, seventy feet high, similar to cedar of Lebanon.

JUNIPERS.

Juniperus Section.

Junipers are evergreen trees, or shrubs, with usually opposite awl-shaped, or minute scale-like rigid leaves; tiny cones of scales, so united as to form a sort of "berry," the somewhat leathery, oily coating including one to three, or more, bony seeds; the natural cosmopolitan redeemers of the desert.

Juniperas drupacea—PLUM JUNIPER. A very handsome long-leaved juniper, the "Habel" of Syria. Tree attains thirty feet; produces a sweet, edible fruit, highly esteemed throughout the Orient.

J–s excelsa—LOFTIEST JUNIPER. Asia Minor, from near the coast to six thousand feet; sixty feet high; handsome pyramidal head; ashy, scaly bark, etc.

J–s Californica—CALIFORNIA JUNIPER. A low tree of the Pacific Coast of California; sheltered and in rich soil, rises to the dignity of a stout tree;

exposed on poor and rocky hills, prostrate; rarely over twenty to forty feet; superior fuel; berries large, shining brown above; scales scarcely visibly tipped at all; seed base (hilum) two-lobed, whitish; outline, egg-shaped; dry and sweetish.

Var. Utahensis. Smaller in all parts; fruit globose; Mount Diablo inland, and to Utah. These, in germinating, show four to six cotyledons; both forms of dense spray.

J–s Mexicana—MEXICAN JUNIPER. A pyramidal tree or bush; spray more slender; the two cotyledenous embryo eminently distinguishes this from the last.

J–s pachyphloea—THICK BARK JUNIPER. A middle sized tree; spreading, rounded top; thick, much cracked bark, and pale reddish wood. It is not easy to distinguish one juniper from another, but the thick oak-bark-like body, and four-angled seed, may suffice. New Mexico and Arizona.

J–s flaccida—DROOPING JUNIPER. Middle sized tree, or bush, with shreddy bark; branches spreading, slender, and drooping; leaves in pairs, with sharp spreading tips, and, like the last, slightly toothed; the tubercled berry scales sharp, and points bent back, including eight to twelve seeds; best distinguished by slender branchlets and rather spreading leaves; abounds in resin similar to Sandrach.

J–s occidentalis—WESTERN PACIFIC JUNIPER. Tree forty to eighty feet high, three feet in diameter; wood whitish, yellowish, or reddish, of several varieties. Of California and Oregon, Texas, Northeast Mexico, Arizona, etc., at five thousand feet or more. Berry blue-bloomed; one or many seeds.

J–s Sabina (var. procumbens)—CREEPING CARPET JUNIPER. They carpet rocks and sandy shores, and make an everliving lawn where nothing else can thrive. May be trained into everlasting hedges. Seeds one to .hree; rough. Maine and North, west to the Pacific.

J–s Virginiana—VIRGINIAN RED CEDAR, or SAVIN. The largest, widest spread, and most useful of all American junipers; pyramidal. Tree sixty to ninety feet high; wood red at heart, sap white; very fragrant; light, compact, durable. Small purplish berries, with glaucous blue bloom; leaves entire on the margin. Canada to Florida, and from North Atlantic to Pacific north. The common "pencil cedar." As an extremely beautiful, lasting, and densest of all hedges, in any soil, is unequaled.

J–s fœtidissima—STINKING JUNIPER. Of Armenia and Tauria. A tall and beautiful tree; Alpine; to six thousand or seven thousand feet.

J–s Mexicana—MEXICAN JUNIPER. Extreme Alpine; straight tree, ninety feet high, three feet in diameter. Exudes copious resin like sandrac.

J–s procera. Stately tree, of Abyssinia, furnishing hard and useful timber.

J–s recurva. On the lofty regions of Himalayas; twelve thousand feet or so. Thirty feet.

J–s spherica. Of Northern China. Handsome tree, of forty feet.

J–s communis—COMMON JUNIPER. At best about fifty feet. Berries used in preparation of gin; also for making an excellent beer, with barley. This species is characterized by the leaves in threes, and being line-like, awl-pointed, and spreading, and not as most others, of close-pressed scales. Hue glaucous, or bloomy-green. Frequently prostrate and creeping. Berries small, size of tiny pea; dark purple.

LARCH.

Larix Section.

Distinguished by the deciduous leaves being clustered in radiating spangles from little warty or woody buds.

L-x (P.) *occidentalis*—"PACIFIC WESTERN LARCH." A tree trim and true as an arrow, one hundred to one hundred and fifty feet high, two or three at the base, boughs short, slender, somewhat depending or "bow-on-the-back" sweep; the general structure of the oriental type—relative to other species, leaves long and slender, of light, thready, radiating, feminine airiness of foliage, color pale bluish or glaucous-green; in Autumn, before the fall, fading to a rich, leather-brown hue; scattered sparsely here and there by cool streams of shady cañons; timber heavy, hard, and very durable; the cones egg-form, an inch or more in length, fringed with bracts, reflexed.

L-x (P.) *lyelli*—"LYELL'S LARCH." Cascade Mountains, Washington Territory; a smaller tree, densely pubescent bud-scales and branchlets; cones more oblong. For waterworks, casks, shingles, ships, etc.

L-x (P. L.)—"EUROPEAN LARCH." European Alps, up to seven thousand feet; one hundred to one hundred and sixty feet; the valuable timber is of great durability, much prized for ship building and general uses; the bark for tanning and dyeing; of great importance for its yield of *Venice turpentine*—by boxing or boring in Spring, these fill during Summer, one half to three fourths of a pint. A variety, the "*Russian Larch*," about eighty feet, of immense value for uplands.

L-x (P.) *leptolepis*—"JAPAN LARCH." In Japan, between 35° and 48° north latitude, up to nine thousand feet. Timber highly valued by the Japanese.

L-x (P.) *pendula Americana*—BLACK, or TAMARACK LARCH. Vermont and New Hampshire, north—pyramidal to one hundred feet; timber white, heavy, resinous, very valuable, resists fire, neither shrinks, cracks, nor rots readily, and is very strong, but is of slower growth than the European; cones the smallest and leaves shortest; prefers cold swamps.

OAKS.

The OAK FAMILY are readily distinguished by their nut acorns in cups, and simple, alternate leaves.

Quercus chrysolepis.—CALIFORNIA (*Golden leaf*) CAÑON LIVE OAK. The largest evergreen oak of California; best types one hundred feet high by eight to ten feet in diameter, with one hundred and fifty feet or more spread, abounding in thick, drooping, graceful tufted sprays, massive knees of the choicest ship timber, equaling the Government Naval *Live Oak* (*Q. virens* of United States South Atlantic Coast); wood, white, very compact, heavy, tough, and durable, superior for tight wine casks, and as it does not warp nor season-crack, for mechanical and naval purposes has few if any equals. *In vernal vesture, both young twig and leaf, clad in soft golden velvety furze*, this alone distinguishes it. Leaves oblong, sharp, prickly pointed; on old trees mostly entire, base, blunt, or sub-heart form; bark, rather flaky and ashy-gray. Acorn cup like the *White Oak;* nut, similar; styles, short. A biennial oak; the best quality grows near the coast.

Q-s wislizeni.—The *Dark Domed Live Oak.* Wintergreen oaks, with solemn stillness of rigid foliage, deep, dark, almost black-green leaves,

body-bark blackish, and limbs livid and smooth, clean canopied, sixty to seventy-five feet high, timber tough, hard, and withstands friction well. Besides general features, the best test at all seasons for this species, where round-topped trees and foliage forms so commingle, is in the leaves being *finely netted with translucent veins, nearly alike above and below*; leathery, shining, and nearly flat, oblong, lance-pointed, size variable, similar to above. Acorn subcockspurred, often striped lengthwise, apt to be velvety at tips; styles, long; cup, deep liberty-cap like; scales horny membraneous; fruit set on short, stout stems, one to several together; matures the second year; young acorns form in the axis of young leaves and wait over to next year.

Q–s douglasii—Blue Highland White Oak. This Summer-green "*Pacific Post Oak*," of sundry other local cognomens, is essentially a foothill oak, prevailing over the middle portion of California up to two thousand or three thousand feet elevation. Tree forty to sixty feet high, rarely eighty; one to five feet thick, of the formal old apple orchard type. But this Blue Oak is rather dim and delusive; the bark almost as if whitewashed, or, in some cases, like the gray of *White Oaks (Q. alba)*. It abounds on hot and arid rolling hills and highland levels; makes good fuel, and has some other utilitarian repute somewhat similar to eastern white oaks in our rural districts; distinguished by pubescent twiglets, winter buds, small, roundish, and nearly smooth; the leaves are small, one to three inches, and half as broad; the margin slightly bayed a little; light blue bloomy green, on very short leaf-stems; acorn set close down on a very short stem, cap hemispherical; scales more or less tubercled; acorn oblong, and tapering to acutish; matures the same year.

Q. lobata—California White Oak. Grandest of all Pacific oaks; but for timber valueless, except when young and very thrifty, then nearly equal to the best eastern *white oak (Q. alba)*.

Q. oblongifolia—Evergreen White Oak. This oblong-leafed *Wintergreen Oak*, as usually seen, is a fine middle-sized tree twenty to forty feet, by two to two and a half in diameter. In the most favorable sites attains to sixty or seventy-five feet, by three to four through; the body, bark, and larger limbs of whitish gray, the final spray more open than most *live oaks*. In general, it has somewhat the spreading habit of the golden species, but the acorn in this is *smooth inside*, the leaf-stem very short (scarcely one quarter of an inch), blade blunt at both ends, one to two inches long, and one half as broad; soft, downy at first, but in age smooth and blue-bloomy; texture thick and leathery, few or no net-veins, rarely here and there a tooth; acorns apt to be set down, cups hemispherical, scales finely tubercled, nuts oblong one half to one inch. In southwest California, Chihuahua, and New Mexico. Wood hard, heavy, said to be brittle (?); leaves mostly deciduous in Spring.

Q. agrifolia—Field Live Oak. At its best this is a grand, imposing, robust, round-topped, wintergreen tree of maritime California. This pastoral oak branches hugely, low towards the horizon, even to one hundred and twenty to one hundred and thirty feet broad from a few feet above the ground; the dome top thirty, sixty, to one hundred feet high—massive; main body four to eight feet in diameter; bark thick, of blackish-gray, and in age rough and chinky; leaves apt to be variable, about two inches long, usually broad, egg-form, warped, convex above; hence vaulted below, no fine net-veins; main mid-rib, spreading, branched above the middle, and a little cottony on the axils; dull, leaden-green, the color fading out on severed twigs; acorns annual, thickened spur-shape; cup liberty-cap-like, flat scales, horny-membraneous; for the most part its leaves are fallen

by the early breath of Spring; wood strong, good fuel; best of the *Black Oaks*.

Q. virens—LIVE OAK. United States, of the southeast Atlantic Coast. A large wintergreen tree, shedding a few leaves in Spring, huge branches spreading low, curved, twisted, and kneed, seldom over fifty feet high, five to seven feet in diameter; main body eight to ten feet, but covering an enormous area of one hundred to two hundred feet span; of very rapid growth in favorable situation and soil; twelve to fifteen inches increase of diameter from the acorn in as many years; wood compact in fiber, heavy, strong, and durable—in short, the most valuable timber known in naval architecture; bark excellent for tanning, and lesser branches for fuel; grand avenue tree; form of foliage and fruit similar to the coast Golden Oak of California.

Q. cornea—HORN OAK. China. An evergreen tree of forty feet; acorns used for food.

Q. ilx—The South European HOLLY OAK. Tree of fifty feet; timber for ships and bark for tanning; from varieties of this, the sweet and nourishing ballota and chestnut acorns.

Q. incana—GREAT GRAY OAK. Himalayan timber tree of great dimensions; a beautiful evergreen.

Q. toza—South Europe. One of the handsomest oaks, and of the quickest growth; evergreen foliage.

Q. densiflora—CALIFORNIA EVERGREEN CHESTNUT OAK. A very large evergreen oak of great symmetrical beauty; seventy-five to one hundred and fifty feet high, seldom more; two to five feet in diameter; limbs not large, spreading horizontally below, rising to erect above, in general outline broadly conic; bark light gray, with the smoothness of luxuriant growth, unequaled for tanning, hence known also as TANBARK CHESTNUT OAK; catkins erect like the chestnut. Biennial acorns clustered, oblong, obtuse, top satiny, as is inside the usually shallow cup, and also the hard horny shell; meat bitter; outside of cup altogether mossy; leaves oblong, two to four inches by about two, sharp pointed, base obtuse on very short stout leaf-stem, parallel pinnate veined, margin toothed like a chestnut. A vast deal might be said of this choice tree but must be left in abeyance. In every way it greatly resembles the Asiatic SILK OAKS.

Q. infectoria—GALL OAK. A small tree of Summer green foliage; the nut galls of commerce chiefly from this.

Q. alba—WHITE OAK. One of the most valuable timber trees of North America; up to one hundred feet or more by two to seven feet in diameter; a Summer-green tree of exceeding elegance and beauty at all stages of growth; shrinks from constant sea breezes, and requires a cool, temperate, and sheltered clime; body branching low, save in the grove and forest, where the shaft is forty to fifty feet; limbs large and spreading below, spray above more erect and uniformly distributed; bark, light ashy to nearly white, finely cuboid chinky, buds small and round; membranous leaves a few inches long and half as wide, bay-lobed bluntly, three or four on each side; cheerful green and smooth above, soft gray-green beneath, on a rather short slender leaf stem; timber tough and durable; long exposed to sun apt to warp and season-crack. Uses almost universal, by ship-builders, wheelwrights, and all artisans. Elliott, of South Carolina, remarks: "The finest of *Q. alba* in United States, and probably in the world, is the country which incloses the Alabama and its tributaries." But is it possible to equal Michigan and upper waters of the Mississippi Valley? No forest tree possesses more good qualities than this.

Q. prinuus—SWAMP CHESTNUT OAK. United States, south. A magnificent tree, seventy to one hundred feet, of colossal pillared body, fifty to seventy-five feet without branches, surmounted by a regular head; four to six feet in diameter; smooth grayish bark; leaves large ob-egg form, coarsely toothed; less regular than chestnut, and slightly pubescent beneath; acorn large, egg outline one-half cupped on a short stem. In the same upland soil as *White Oak*, or by swamp margins, timber nearly equal or preferred in hot climate. Red dye from the bark. Foliage deciduous. *Q. michauxii* and *Q. castanea* confounded in name and use, only trivially distinct.

Q. montana—The MOUNTAIN CHESTNUT OAK. A tree belonging to the large division of Chestnut Oaks, but smaller; only thirty to fifty feet high by one to two; along the base of the Alleghany Mountains of East United States, in rough rocky situations, and coarse gravelly soils; hence, also known as ROCK CHESTNUT OAK. Leaves long, ob-egg form, white, velvety beneath, coarsely toothed; acorn and cup as the preceding, only half the size. Both timber and bark the most valuable of the *Chestnut-like section.*

Q. mongolica (Fischer)—"MONGOLIAN SILKWORM OAK." Mandaschuria. N. B. One of the two species on which mainly (if not entirely) the East Indian OAK-SILKWORM (*Bombyx Yamamai*) is fed and reared—an insect peculiar to oak trees, as shown by Dr. Hance.

Q. Serrata (Thunberg)—JAPANESE SAW-TOOTH SILK OAK. These two Asiatic *Silk Chestnut Oaks* so nearly resemble our California *Q. densiflora* as scarcely to be distinguished. This is one of twenty-three known oaks of Japan, and is said to yield the best food of any for the OAK SILKWORM (*B. Y*–, as above.) Specimens may be examined in the hands of Mrs. Hittell, of San Francisco, California.

Q. sideroxylon (Mountains, Mexico). An oak of great size, of compact timber, almost imperishable in water. In the cooler mountain regions of Mexico are many other highly important timber oaks, to wit: *Q. lanceolata*, *Q. chrysophylla*, *Q. reticulata*, *Q. laurina*, *Q. obtusata*, *Q. glaucescens*, *Q. halapensis* (Humb.), and *Q. acutifolia* (Nee.)

Q. squamata. One of the tallest Himalayan oaks; lasting.

Q. bicolor—SWAMP (Chestnut) WHITE OAK (by some only var. of *Q. prinus.*) Common on the lowland marshes of North America; variable; some very handsome; large size, eighty to one hundred feet, by five; bark rough, scaly; wood, brownish, heavy, compact, fine grained, and elastic; some boat builders prefer it to the typical white oak. Best identified by large leaves, six to seven inches, wedged at base almost entire, or a sub-lobe above the middle, whitish downy beneath; acorns on long stems, few, but sweeter than the *White* oak.

Q. macrocarpa—BUR-OAK, OVER-CUP, and MOSSY-CUP WHITE OAK. A handsome medium-sized tree of luxuriant foliage, and large, mossy-fringed cup, nearly inclosing the globular nut; sixty to seventy feet high by two to four diameter of body; bark ashen, smoothish; leaves large; lyrately lobed; narrowed at base; general outline broadening out above; pear-shaped; timber solid, smooth-grained, tough, stiff, and strong, durable; for wagons less liable to season-crack than *White oak.*

Q. tinctoria—DYER'S QUERCITRON, BLACK OAK. A large upland oak of rich soils, with spreading habit; sixty to seventy feet high; two to four in diameter; outer bark black, hence the common name; yellow within. The best test of the species is, chewed *it yields* a bitter *yellow dye.* "*Quercitron*" comes from the tree, and is rich in tannin; leaves darker, thicker, shorter, broader above, less bayed, and weak, powdery, hairy beneath, at least in axils and lobes shorter pointed than the true

Scarlet oak (*Q. coccinea*); also, the depressed globular or ovate acorn, with a *yellow* areolar base; cup and scales unlike; former set close down; latter short, pubescent, creamy within; wood good; Autumn foliage mostly yellowish to light russet brown, etc.

Q. coccinea—SCARLET OAK. A large tree, seventy to eighty feet high, rarely more; two to four in diameter; limbs little spreading, and form upright or of oblong top; nearly as graceful as the elegant *Pin Oak* (*Q. palustris*), and next to it the deepest bayed foliage, and these broadest at bottom, besides a longer leaf and leaf stem than the preceding, and the brilliant, open foliage in Autumn very ornamentally scarlet, hence the common name. Thin bark represents the relative smoothness of luxuriant growth; inner portion of light reddish hue, and yields no color, and less bitter on chewing, but abounds in tannin; acorn larger, oblong; cup with tapering base; white within; wood for staves, etc., inferior to the black oak, for either fuel, wagons, or other rural uses.

Q. suber—CORK OAK. Tree about forty feet high; acorn sweetish; age two hundred years or more; from south of Europe and north of Africa; evergreen. After twenty years it can be stripped of its bark every six or seven years, but the best cork is obtained from trees about forty years old and over. Flourishes finely in California, and proves of rapid growth at Fresno, Santa Barbara, and elsewhere. A plantation of these acorns would yield a never failing fortune.

Q. rober—BRITISH OAK. Extending through Europe and Western Asia; attains great age and enormous size. Of two principal varieties:

Q. sessiliflora—the DURMAST OAK. Darker and heavier wood, more elastic, less fissile, quickest of growth, thrives on poorer soils; bark richer in medicinal, dyeing, and tanning properties.

Q. pedunculata—ENGLISH ACORNED-STEM OAK. This variety supplies most of the oak timber of Britain for ship building, and is the best for bending under steam; also preferred for joiners' work.

Q. ægilops. South of Europe; tree of the size of the BRITISH OAK; cups known as "Valonia," for tanning and dyeing—unripe acorns as "Camota" or "Camatena," for same purpose; wood famous for furniture.

Q. cerris. South Europe; —— feet high, or equal to English Oak; in suitable localities of quick growth; foliage of Summer-green, or, also, Winter-green; wood in request by wheelwrights, cabinet-makers, turners, and for building purposes.

Q. phellos. United States, south—WILLOW OAK. A slender tree for height; along margins of marshes and streams; thirty to sixty feet high; bark dark leaden, smoothness of thrift; deciduous; leaves lance-linear, tapering each way like willow, smooth, thick; biennial acorn, small, round, cup shallow; timber famous for felloes; lasts thirty-odd years of severest constant use; never season-cracks.

Q. palustris—PIN OAK. An exceedingly handsome middle sized tree, with the most light, neat, and elegant foliage of any known oak; relatively tall, and slender limbs; small and set in the body, not unlike pins, hence the name, "*pin* oak," and "*palus*," also, a peg or pin; found on the broken hills of brooks and fountain streams of sweet drainage; also seldom along alluvial margins; leaves oblong, smooth, and shining, both sides bright green, very deeply pinnatifid-bayed, gracefully broadened near mid-rib; lobes spreading, cut lobed and toothed, and these acute pointed, on very slender stems, rather long and weak; fragrant, acorn globular, half inclosed, sweet; timber stiff, strong, and elastic, highly ornamental; has sweet galls. In Eastern States the tree is relatively small, say forty to fifty feet;

in the West to eighty or more; never in swamps (?); wood remarkably elastic, strong, and tough, though coarse grained.

Q. castanea—YELLOW CHESTNUT OAK. A very graceful tree, growing sixty to seventy feet high, two to four in diameter, in rather rich soils of the United States; leaves narrowed, oblong, acute, and sharply and regularly toothed; quite similar to the chestnut, soft, hoary, downy beneath; hemispherical cup, thin, with fine close-pressed scales; acorn small and sub-oblong; also further distinguished by the very yellow wood and flaky bark. The timber of this beautiful tree is strong, elastic, and well suited to wheelwrights.

Q. rubra—RED OAK. Tree of one hundred by four or more feet; wood of little value, never known to season, and almost fireproof; bark rich in tannin; Autumnal tint of foliage beautifully red; only of landscape use.

Q. Kelloggii—PACIFIC BLACK OAK. In Yosemite Valley, California, this oak is over one hundred feet high, and more than eight feet in diameter; in Autumn, beautifully golden-hued and ornamental; timber said to be the best of the black oaks when well seasoned; only a Summer green tree, with open foliage; between the Eastern black and scarlet oaks; bark black and rough.

Castanopsis chrysophylla—GOLDEN LEAF PSEUDO CHESTNUT, or *California Evergreen Golden Chestnut.* Abounds in the redwood region of California Coast Range. Largest on the rich red loamy rolling hills about fifteen miles inland. Over one hundred feet high and five to eight feet in diameter; clean columnar body of colossal proportions, fifty to eighty feet without limbs; bark of the true chestnuts. Leaves thick, leathery, smooth above and dark-green golden-velvety beneath. The male flowers like the chestnut. Bur horrent with branching spines inclosing one to three hard-shelled nuts, of shape, taste, texture, and similar form to the BEAKED HAZEL *(C. rostrata).* Timber splits well, works easy when green, hardens as it seasons, is tough, elastic, and lasting; stains and polishes finely; ornamental, of glistening faintly reddish tint. The "Chinquapin" var. minor is only smaller—on dry, fogless hills, comparatively. Found from Oregon to Monterey, up Sierra Nevada, to six thousand feet.

C–s argentea—PSEUDO-SILVER CHESTNUT. Mountains of India. Yields an edible nut. Timber valuable. Has also its *minor* shrub-form variety.

Castanea Sativa—Miller *(vesca)*, var. *Americana*—The AMERICAN SWEET CHESTNUT. Among the largest and tallest trees of the ordinary forest; massive, pillared, trunk clean of branch, and diminishes little—like our *Golden Chestnut*—up to fifty or seventy-odd feet, and thence rejoicing to one hundred and fifty or more; five to eight feet in diameter. Bark light brown, the swift-water-line-crevices apt to be broad but superficial; more rough in great age; the large lance leaves regularly rib-veined to a coarsely and sharply toothed margin. Foliage turns to a cheerful yellow in Autumn ere it falls away. Catkins of male flowers erect, straight, in clusters radiating the tips of the twigs; the ball bur at their base horrent with spines and inclosing one to three nuts, sweeter than the foreign. In dry rocky, gravelly ridges, of light yellow loamy soils, generally, on the North American continent. Common to South Europe, and temperate Asia, these woods abound, and the timber, though coarse grained, is in general request as it is light, somewhat elastic and strong, resists vicissitudes of seasons nearly equal to the best, and when well seasoned by age it neither shrinks, swells, warps, nor cracks; hence, famous for large wooden cylinders and many mechanical structures that require nice stability. A most valuable tree, whether for shade or shelter, timber or fruit. It also attains to

great age and size. Mt. Etna tree two hundred and four feet or more in circumference.

The Beech is a lofty, spreading tree of damp and cool regions of the globe, notable for its smooth, white or bluish-gray bark, sharply three-cornered oily nuts, one and two in a mossy, four-cleft bur; male flowers of pink and yellow, tassel-like, are hung on long silken threads; females seated in pairs. Few species—half dozen or so—distributed in Europe, Asia, America, and Australia. Mostly deciduous, with fan-folded buds.

Fagus—AMERICAN BEECH (var. *Americana*). This is an elegant tree, but by no means massive nor masculine; sub-conic, from sixty to eighty feet high, numerously branched, every two or three larger, thus alternating and in-filling its canopy to greater depth; the fine twigginess of branchlets gives it close shade and fine, delicate sheltering qualities, unites softness of foliage and symmetry of form. Best known by the spindling Winter buds, tasseled male flowers hung on long silken threads, females seated in pairs, later-on the sharply three-sided nuts in a mossy bur, or, at-length in a little four-lipped urn; leaves oblong egg-form, taper pointed, coarsely toothed. In this Summer-green garb it always presents a neat and clean, delicate and cheery verdure; nuts sweet; wood closely homogeneous, grain hard and smooth, sap wood best, more durable, tougher, and least liable to warp. For planes, bowls, trenchers, and trays, chairs, for tools and turnery, fuel, etc. Thrives best on rich, damp, rocky soils on a close substratum of clay.

F–s dombeyi. CHILEAN EVERGREEN BUCH OR COIHUE. Of grand dimensions for canoes of ten tons freight; the wood harder than the following other Chilean species, although otherwise their qualities are similar. As this extends to the Chonos group, and perhaps still further south, is adapted to middle Europe and North American forest culture.

F–s obliqua. The ROBLE of Chile, by aborigines COYAM. A tall tree with a straight stem, three to four feet in diameter; wood heavy and durable, well adapted for posts, beams, girders, rafters, joists, etc., but not for flooring. This is one of the few Chilean trees with deciduous foliage, says Dr. Philippi.

F–s procera. Known in Chili as RAULI; also deciduous, colossal, wood splits well; adapted for staves; finer grain than *obliqua*, and much used for furniture. (Dr. Philippi.)

HAZEL, FILBERT.

Corylus.

The hazels are mostly shrubs, or low trees, common in the cooler zones; the caterpillar-like catkins come out very early, pending the tips of twigs; the fertile or females, like recurve-radiating pink threads; the fruit-husk, like a cap, from old Saxon, *heesle*, a cap; hence, *Hazel;* also, the botanical, from the Greek, *corys*, a helmet, or *Helmeted-nuts.* As California and the Pacific Coast of United States includes the most promising latitudes, besides being favored by a relatively more genial clime, well broken drainage, and humid breezes suited to culture of the lesser nuts, as well, we devote more space to their notice than first intended, because so little attention has hitherto been devoted to them, to the manifest loss of annual millions to the State.

Corylus Americana—AMERICAN HAZEL. In the native wild state a Summer-green shrub, six to twelve feet high, with erect branches, leaves roundish heart-form, angled and toothed, downy beneath, on a short leaf-stem;

fruit burs large, round-clustered, cut-leafy-like-lipped above the nuts, which are numerous, and by brief culture equal if not superior to foreign species, *e. g.* a single bush in Princes' garden gave half a bushel of nuts in a season. They require little or no care; could be planted on the borders of fields, to say nothing of their adaptability to any soil, to the roughest, rockiest, and most forbidding, and we might add, otherwise useless localities; besides, their roots do not obstruct the growth of grass in pastures. Only the best results, however, come from culture; the European Hazel, no better than ours, Mr. Webb, of Calcot, England, reports raising two thousand six hundred pounds on an acre, which sold for $900, besides apples, pears, and potatoes from the same land; but all such marvels require high culture. They come into bearing from the seed in three to seven years.

C–s avillana—EUROPEAN HAZEL. A shrub about eight to twelve feet high, branching and suckering like our own native species, and equally suited to almost any soil; planted for the nearest, say eight feet three inches, which gives six hundred and forty to the acre (although we should prefer twelve to fifteen feet); ground to be dug once a year, or better deep plowed. Keep a clean crop of potatoes, or the like, between, and they come into bearing in five years. My Bro., Maj. H. K., of the East, found them to fruit in three or four; ours by express were given Hon. Geo. Hobler, of Alameda, and lost, but with care, we feel safe in saying six or seven years here would bring them into prime bearing. It is a pleasure to refer to Mr. Webb, of Calcot, England (a nut culturalist and author of a pamphlet on "Nut Culture"), who says he employed six laborers a quarter of a day gathering off of one tree, all witnesses to the weight of one hundred and ten pounds of cobnuts.* They are there considered certain bearers, six out of seven years; equal to the best perishable fruit orchards. There are, moreover, other points well to mention, once for all, relative to these and similar nuts. The market is always a sure one—transit easy—they are not injured in boxes, tubs, or barrels, for a few months, any more than flour, by sea or land, and if packed close in large mouth earthern jars, husk and all on, will keep perfectly fresh and sweet for at least one year, a damp cloth laid over the mouth simply. Given ample space in apple, pear, or plum orchards, crops can be also cultivated meanwhile. Over $1,000 per acre reported realized, from which we presume it is profitable.

C–s colurna—CONSTANTINOPLE NUT–TREE. Attains to sixty feet, the tallest of all the hazels, and is of rather quick growth. There are thousands of gulches that would support a little grove of these to profit, here and there, on this coast.

C–s heterophylla—JAPANESE HAZEL. A promising species for trial in our coast range cañons.

Guevina avellana—Molino (*Quadria heterophylla*, R. and P.)—CHILIAN EVERGREEN HAZEL. This hazel tree attains to the height of thirty feet; yields the hazel nuts of South America. Being of similar latitude and coast exposure, there is no reason why this would not thrive well here and serve the admirable purpose of shelter belts, with their annual bounty. One of the most lovely trees in the world; snowy white plumes of flowers simultaneously with the ripening coral red fruit; wood tough and elastic; used for boat building.

Corylus rostrata—BEAKED HAZEL. The Pacific United States variety of this shrub is four to twelve feet high, two to six inches in diameter, of flexile

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* Cob Filberts or Hazels. N. B. The Cobnuts of Jamaica are the seeds of a SPURGEWORT or *Euphorbiaceous shrub Omphalea*; most delicious and wholesome, if the embryo is extracted (if this is not done they prove too cathartic).

and arching habit, suckers and spreads on moist and foggy coast, amid half shady woods; prefers broken and hilly situations; greatly abounds in Oregon, and has become of many millions of commercial value as hoops for barrels, kegs, and boxes. This hazel has roundish sub-heart shaped leaves, two to four inches long, on short leaf-stems, little angled and pointed above, with doubly-toothed margins, soft, downy-hairy; nut oblong, tightly inclosed in a green husk, which has a dudy fit below, lengthened into a snout or beak like a narrow necked flask, and jagged or ruffled at the tip; also distinguished by a dense velvety, somewhat nettly-bristly husk; those bunches of burs that grow on the ends of the twigs seldom perfect more than two or three nuts of inferior size and quality. The chief reason why this native species is noticed at all is as a natural guide to the most suitable situations, soils, and climes, for the better sort.

Brabejum stellatifolium of South Africa—we notice here although a Protead. The nuts of this shrub are edible, similar to the Chilian *Guevina avellana*, but the fruit is to be roasted, as otherwise it is deleterious.

Macadamia ternifolia. Nut tree of sixty feet (East Australia); taste of hazels.

Carpinus Americana—AMERICAN HORNBEAM. A small tree allied to hazel and oak, twenty-five to thirty feet high, by half to a foot or so in diameter; bark smooth, as in beech, and of bluish iron tint; hence, also called "BLUE BEECH." This color, and likewise hard quality of wood, has also given it the name of *iron wood*. The body is ridged like deer's horns, hence the name, and it equally signifies *hard beam*; bears the fruit in terminal, ragged, hop-like catkins, scales of it one-sided and leaf-like, laterally toothed, changed in this species into halbert-shape or three-lobed, formed into a flaring cup. The eight-sided seed or nut, in a close-fitting ribbed husk, sits in the axil, and, as it grows, crowds it more open; the leaves thin, soft, and like the sweet birch, but chewed have no spicy wintergreen flavor. The splendor of its Autumn hues of scarlet, crimson, purple, red, or orange, vies with tupelo, oak, maple, and the gayest of the sylvan train; body fluted, long pending seed tags, and altogether, presents a peculiar tree—a worthy ornament of easy culture near streams. Wood white, compact, and close-grained, of great toughness and strength.

Ostrya Virginica—HOP HORNBEAM. The hop hornbeams are very handsome, small and slender trees, easily distinguished in fruit by the pretty pending cylindrical seed-vessel tags, two to three inches long, in general outline similar to a hop, formed of flattened bladder-like sacks inclosing the nuts. The exceedingly tough twigs have the dots on the bark lengthened horizontally, as in birch and cherry. On the body in age it cracks, scales up, and divides into very finely shreded fibers. Leaves similar to sweet birch, beech, etc., but more eliptical and long-pointed, its thin, delicate, and soft foliage, level-sprayed and tasseled, is remarkably ornamental. Wood wonderfully firm, stiff, and tough, famous for levers, hence called "*lever wood*;" and from extreme hardness, also *iron wood*, for cart-stakes, binding poles, gads, etc.—"Blackhazel," used for cogs, mallets, and mauls. On banks of streams six inches to a foot through, twenty to forty feet high. Autumn tints, shades of orange and yellow, brown, or russet. Of easy culture.

*Juglans**—WALNUTS. These are best known by their undivided nut coat; the tags also are mostly single, but the leaves are made up of very many leaflets—five to twenty odd—in seven to ten pairs, and an odd one

*From Latin, *Jovis Glans* (Jupiter Nut)—from its superior excellence.

at the end. Lofty timber trees of north temperate regions, of great value, also bearing sweet and wholesome nuts abounding in oil.

Juglans nigra—Black Walnut. Eminently one of the most majestic trees of United States, Atlantic west; seventy-five to one hundred feet high, three to seven or more in diameter. The solemn domed head, of great magnitude, is of the priestly type; their massive mantled boughs, of large-winged but soft luxurious foliage, soar gracefully aloft and afar towards the horizon with easy dignity of motion, casting a dense, dark shadow that tolerates no undergrowth. Useful in all conceivable ways, and elegantly ornamental for avenues and public shades. Timber of finest grain for finish, and for gun stocks and much cabinet work superior to mahogany, famous for elegance, tenacity, hardness, strength, durability, etc. Growth from the nut, when planted where it is to remain, is both certain and rapid. Nuts, with due degree of culture and care in collection and preservation, as harvesting early, the shuck on and dried in the shade, equals the European; requires a rich alluvial soil. As the sap abounds in sugar, fermented, it yields the intoxicating liquor known as "walnut wine;" wood of dark purple or violet hue, deepening towards black with age.

It should be observed that nut-bearing trees, naturally of lofty growth, will not prosper if tap-roots and tops are cut away; their collateral lower branches being simply nurses and wood constructors; they build but do not bear; hence, their leader, both above and below ground, must be left alone—should be planted where they are to remain, or only transplanted very young, and for other manifold reasons.

J–s Californica—California Walnut. A favorite and elegantly ornamental shade and avenue tree of California, forty to seventy-five feet high, two to four in diameter. All hitherto known to us are remarkably shapely, oblong, cylindroid, or urn-topped, and umbrageous; possibly, in the decrepitude of age, it may prove alike picturesque with the *White*, or *Butternut* species *(J. cinerea)*. The combined leaf is of five to eight pairs of leaflets, and a terminal odd one; these are about two and a half inches long, narrowing from near the base into a sharp point; tags often in pairs, four to eight inches long; fruit globose, little compressed; surface slightly map-river gulched, or grooved, and almost smooth; shell very thick, the meat-kernel retaining its original sweetness and vitality for unnumbered years. For beauty, grace, richness of foliage, rapidity of growth, at all points of use for durability or ornament, it is unsurpassed by any deciduous tree of the Pacific Coast, but it requires the rich alluvial soils by the margins of streams to keep alive a good reputation.

J–s rupestris—Dwarf Walnut. A small shrub or tree, from six to twenty feet or so, well suited to limited lawns, unobtrusive foregrounds, and narrow avenues; tags two inches long; compound leaves of six to twelve leaflets, narrowed above the point, much attenuated; nuts, like good sized musket bullets; shell hard and thick. Texas and New Mexico.

J–s regia—The Royal Anglo-Asiatic Walnut. The common English or European walnut, originally from Central Asia; attains to eighty feet or more, and lives for centuries. These nuts of commerce are of world-wide use as an article of diet as nuts or oil, the latter also in the preparation of fine colors. For first-class fruit the trees are grafted. An almost huskless variety from North China can be grown in cold localities, as it thrives there on mountains, and even in middle Europe at two thousand feet. Nuts, with coats carefully dried on, and packed in casks between layers of dry sphagnum or moss, are sure to arrive in the best condition for germination, ready for planting where they are to grow, viz., in deep, rich, alluvial

soils. It is well known the wood is light and tough, etc., for the choicest cabinet work, gun stocks, and a thousand similar uses.

J–s Sieboldiana—JAPANESE WALNUT. Thrives well in California, but for the best results requires strong land; cluster-fruited; nuts large and profitable for culture; best planted where it is to remain; cutting off tap root or top leader is a dire calamity.

J–s stenocarpa. From the Amoor territory; allied to *J. mandschurica.*

J–s cinerea—BUTTERNUT. This low, and at length broad-headed tree is thirty to forty feet high by two to four feet through; beautiful in youth, picturesque in age; best distinguished by its oblong, snouted nut, with its mummy-clad and clammy hide, or sticky, velveted skin; gathered so soon as early matured, and carefully dried in the shade, it is very sweet and pleasant flavored, and not liable to become rancid with age. The old bark is ashy gray, hence, also named WHITE WALNUT. Of very rapid growth and remarkably graceful in its upright, urn-form state into age, when it spreads abroad more and becomes flat topped and remarkably picturesque and prolific. A tree eminently suited to sandy and rocky soils, where the roots readily reach moisture, it also does well on bottom lands, borders of streams, lagoons, and lakes. Common in the northern and middle Atlantic United States. Timber light and bright tint for cabinet-work.

HICKORY.

Carya.

The hickory section of the WALNUT FAMILY (*Juglandaceæ*)—found only in America—have their tags mostly three-parted; the shuck of the nut opens by four seams, and the compound leaves of fewer leaflets, say five to nine—rarely fifteen.

They are all of them very stately, grand, and beautiful trees, whether seen in their Summer green and graceful foliage or in the golden gay and varied parade dress at the festive Autumn scene—always sylvan clouds of woodland glory. Wooing, they wave the wind with the grace and ease of a grain field, bow in princely dignity before the rolling storm; yielding to the fiercer tempests, as the good and true are wont to do, integrity of body or limb is never broken, but with wonderful toughness and amazing elasticity they ever return joyous victors over the warring elements; hence the useful, ornamental, clean shade, and secure shelter tree. They yield the most delicious of nuts; withe tough and strong; wood, as timber or fuel, is so excellent as rarely to be equaled, hence unnumbered uses. Exposed to moisture, however, the timber is not very durable.

Every species of hickory preserves one uniform towering tendency of their tribe, and may therefore close their ranks in the grove like apple and similar fruit trees. They can be best raised to advantage by germinating in a propagating house and then planted where they are to remain, but so plentifully as to allow for squirrels or the like depredators. They can be thinned to profit, to any required stand.

Carya alba—SHELLBARK HICKORY. The SHELL- or SHAGBARK has five large leaflets; shuck thick and deeply grooved at the seams, where it opens into four pieces, one larger; the nut suborbicular, slightly compressed and angular, and though they vary much in form are mostly large—one to one and one half inches by half inch wide, the best having thinner shell, fat or rounded and swelled form, with plump easily extracted meat of a superior sweetness. The richness of the kernel is apt to keep pace with the roughness of the bark. A beautiful, towering, and stately tree, often slightly

spread-urn topped. Seventy to eighty feet; about two (rarely three) feet in diameter. Grown by itself from early age it broadens more, but the branches of all the tribe are slender and seldom very open-headed. Abounds in United States east; thrives best in rich moist soils, preferring black humus among rocks and ferns, or rich loamy hillsides on the edge of forests or the borders of fields. The ashy-gray bark, as indicated, flakes off in long large loose plates, greatly warped up at one or both ends. It really seems very strange that a wild fruit of so great excellence should have received so little attention by enterprising and intelligent culturists, who could not fail to improve this as other fruits. And even as forests the timber is invaluable, splits well, and has so many manifold uses there is scarcely any end to enumeration of the uses of mechanics and artisans. The white sap-wood of the most rapid growth is the best; the red-brown heart, though strong and hard, is neither so tough nor elastic. The worst fault to be urged is that it warps and season-cracks badly; but it is not attacked by worms when in salt water.

C. sulcata—THICK SHELLBARK. This has seven to nine leaflets; oval fruit, four-ribbed· above the middle, and furrowed. Nut strongly pointed, slightly flattened; thick yellowish shell. Timber as above.

C–a tomentosa—MOCKERNUT HICKORY. This tree is sixty to eighty feet high, about two feet through; bark relatively smoother than the preceding; in mature age furrowed, but fibers more or less interlocked; leaves large seven to nine leaflets, and these, with the twigs, very starry-wooly when young; the resinous hickory odor rank; this *white-heart, square-nut hickory*, so called in the one case where the growth is rapid, in low grounds—although in old age a small dark heart does exist—and in the other because some have nuts quadrangular-like, *i. e.*, with prominent, sharp angles, others with the shuck pear-shaped, and reluctantly opening more than half way, in this species becoming very hard; nuts very white, kernel not so easily extracted, shell thicker and harder; often grows in poorer soil, but more slowly, and the timber is not so good, but as fuel nearly equal to any; the fruit ripens in October.

C–a glabra—PIGNUT or BROOM HICKORY. A large tree, thirty to seventy feet high, one to three in diameter; the close bark finely checked but never shaggy; rather dark hue; very tough and slender branches numerous (sprouts used as *hickory withes*); common footstalk of leaves smooth, leaflets three to seven, narrow; fruit mostly fig-shaped; shuck thin, tough, and leathery, reluctantly opens part way; nut oblong, shell hard and not thick, kernel dark pellicled, its hazel taste becoming finally bitterish and astringent—rarely palatable; wood varies somewhat in quality with sundry varieties, with the general excellence of their class; in this species it is apt to be found in the greatest perfection, it is therefore preferred for axletrees of carts, heads of mallets and beetles, and handles of axes, whenever young and *exceedingly thrifty*, which may also be said of both the preceding; for fuel not to be excelled; affords a black dye by vegetable acids.

C–a amara— BITTERNUT HICKORY. By some considered a variety of *glabra*, but we think sufficiently distinguished by seven to nine or eleven small, narrow, shapely, saw-toothed leaflets, which give it the slender, light, clear-cut grace of the ash, rising columnoid and urned up to fifty feet, and on up to sixty or seventy; very bright yellow bud, middle sized fruit globose, seams prominent; nut broader than long, wavy swelled surface, thin shell, kernel plaited or corrugated and intensely bitter, with powerful astringency; in swamps, or, if on dry and sandy soils, contiguous to streams or lagoons; affords a yellow dye; timber inferior to other hickories; among

beauties this is the most beautiful: the body even and symmetric; shape tapers gracefully; bark not at all shaggy.

C–a microcarpa—SMALL-FRUITED HICKORY. A symmetrical conic tree, forty to sixty feet high, one to two in diameter; upland, loamy woodlands of New England and Pennsylvania, southwestward; bark even, not shaggy; leaflets, five to seven oblong-lanced, saw-toothed, *glandular underneath*, but not downy; nut about the size of the hazel; husk thin, smooth, shell rather thin, and nearly even; kernel greenish pellicled, inferior flavor.

C–a oliviformis—PECAN NUT. This very handsome and valuable hickory of the Southwestern United States is like all of the tribe in favorable soils and climates, of the most rapid growth of any hitherto tested in California. The smooth leaflets, thirteen to fifteen, are saw-toothed, of lance-sickle shape, smooth; nuts, oblong, olive-like, and thin shell; meat, delicious; but to our taste none surpass the *shellbarks*. The Pecan tree is a refinement upon the aspect of the best types of the California Walnut, being more lithe and delicate.

The AUSTRALIAN MOCK HICKORY (is *Acacia Supporosa*). A tree fifty to one hundred feet or more by one and a half to two feet thick; makes tall, straight masts and spars; is exceedingly tough and elastic; fine for gig-shafts, handles, gun-stocks, etc. East Gippsland.

Pterocarya fraxinifolia—ORIENTAL PSEUDO-HICKORY. Of central Asiatic Russia; a kind of *walnut tree*, which, with *P–a Stenoptera*, Dr. Hance recommends to be adopted as trees both for ornament and timber; and so perhaps also the Japanese species.

Engelhardtia spicata is another SPURIOUS WALNUT of the mountains of Java and the Himalayas; reaches two hundred feet high.

Casuarina quadrivalvis—COAST SHE-OAK. Of southeast Australia; thrives on sandy, barren places even up into the inland hills; sixty feet; of quick growth; seeds early and copiously, easily raised; well tested in California; the male tree fine for avenues, drooping; cattle fond of the foliage; checks coast sand; one of the best for timber belts.

C–a suberosa—ERECT SHE-OAK. Forty feet, beautiful shady species; *C–a trichodon—Frederiana and Dugeliana;* all arboreous, and yield valuable timber. *C–a glauca*, DESERT SHE-OAK, widely distributed in Australia; in favorable places, eighty feet; wood hard, durable, remarkable for its rapid growth, for shelters, and most speedy supply of fuel, a remark that applies to all of them—the heaven-sent redeemers of deserts.

Ceratonia siliqua—CAROB-TREE. Of the Mediterranean; thirty feet high; resists drought well; wood, pale red; saccharine pods. Algaroba, or ST. JOHN'S BREAD, of value for domestic animals; seeds germinate readily.

Eucalyptus marginata—The JARRAH MAHOGANY. Of southwest Australia; famed for its wood, which is neither attacked by chellura, teredo, termites, limnoria, and other pests of the land and sea, and therefore so urgently sought after for wharves, jetties, and all naval structures; also underground work and railway sleepers. Vessels built of it have been able to dispense with copper-plating. The timber is very strong, close grained, slightly oily, and resinous. This property is also shared by the RED GUM-TREE (*E. rostrata*), both of which are of rapid growth in Oakland, as Mr. Nolan fully tested on his grounds many years ago. This wood works well, makes a fine finish, and ship builders in Australia consider it superior to oak, teak, or indeed, any other timber. The tree in its native haunts is chiefly on ironstone ranges.

E–s ficifolia—CRIMSON-FLOWERED EUCALYPT of West Australia.

E–s rostrata.—The RED GUM of Victoria, South Australia, and river flats of the interior, or over the whole Australian continent. The wood is of

extraordinary durability underground, hence highly valued for fence-posts, piles, and railway sleepers; is also extensively used by ship builders as main stem, stern post, inner post, dead wood, floor timbers, futtocks, transoms, knight head, house pieces, cant, stern, quoter and fashion timber, bottom planks, breast hooks and riders, windlass, bow rails, etc. It should be steamed before it is worked for planking. Next to Jarrah (from West Australia), this is the best wood for resisting the attacks of sea worms and the white ants. (For details, see reports of Victorian Exhibitions of 1862 and 1867.) The tree attains to one hundred feet or more.

E–s amygdalina—LOFTY PEPPERMINT. In sheltered springy forest glens and deep rich ravines, both colossal and the tallest tree on the face of the globe; often measures four hundred and twenty in the Dandenong Range, and on the sources of the Yarrah, still higher; we have heard of them four hundred and ninety, or nearly five hundred feet—these not fully verified; those tested show the same amazing rapidity of growth as our specimens of *E. globulus*, but in open uplands is only a middle sized tree; the fresh leaves and twigs yield two to four per cent of oil. The wood is fissile, suited for rails, shingles, house building, for the keelsons and planking of ships, and for other purposes; the inner bark is adapted for all kinds of coarse paper; is found to flourish well in California.

E–s Stuartiana—One of the WHITE GUMS. Vicinity of Victoria; nearly equals the above *Almond Peppermint*, and only surpassed by *E. divirsicolor*, or *E. colossea*, which Mr. Nolan fully tested in California more than a generation ago; found also in Tasmania and South Australia; of the bark can be made coarse packing paper and pasteboards.

E–s obliqua—STRINGY BARK. The main part of a wide extent of forests of barren mountain ranges of Victoria, Tasmania, St. Vincent Gulf to Gippsland; tree three to four hundred feet high; bark makes good mill and pasteboards; pulp bleaches readily; universally used for thatching, as it is very thick, bulky, and easily separates.

E–s globulus—BLUE GUM of Victoria and Tasmania (not the *Blue Gum* of New South Wales and West Australia). Near the coast, in open spaces of diminutive size, but in deep declivities nearly as colossal and lofty as any of the preceding; stronger than teak or oak; ship carpenters' outworks, fence rails, and railway sleepers and ties last nine years; good shafts, spokes, etc.; well tried in California.

E–s longifolia—WOOLYBUTT. A tall timber tree, like *Ironbark*, for spokes; has a high character for durability, for fences and as posts; lasts more than twenty years; superior fuel. From Victoria to East Gippsland.

E. leucoxylon—IRONBARK. Suited to poor soils of high ridges. Locality as above.

E. melliodora—BOX PEPPERMINT AND YELLOW BOX. On low open ridges of Victoria miocene; a middle-sized tree.

E. citriodora—THE LEMON-ODORED EUCALYPT. This tree combines with the many virtues of eucalypts the advantage of yielding from its leaves a large supply of volatile oil, of excellent lemon fragrance. Tree tested at Berkeley.

E. sideroxylon—IRONBARK. Reaches one hundred feet or more; timber of great strength and hardness; prized for durability by wheelwrights, carpenters, ship and railroad builders, miners, and turners; considered the strongest Australian timber; proved in California.

E. diversicolor—THE KARRI. Of southwest Australia; a colossal tree; exceptionally four hundred feet high; timber excellent; for shady foliage of dense growth, one of the best for extended avenues; thrives well at Melbourne.

ELM FAMILY.

Ulmaceæ.

They are chiefly grand and graceful trees of great expanse, and among the most useful timber, shade, and shelter trees of the north temperate zones of both old and new worlds, allied to the nettle and bread fruit; their heads rounded, and branches and twigs more or less arch urn-form; simple leaves saw-toothed, alternate sickle-pointed, roughish and unequal sided, set alternate in two rows on the sides of twigs; seeds roundish, wafer-winged, or membranous margined; one cherry like nettle tree.

Ulmus Americana—AMERICAN WHITE ELM. A Summer-green tree of marvelous majesty and extreme elegance; rises seventy-five to one hundred feet or more; four to eight feet diameter; the vast limbs in successive graceful curve or arching gothic symmetry, and fountain spray unrivaled; the pending branchlets of these sylvan curtains are smooth and not corky, graced with a two-rowed foliage, quite unequally subheart-form at base, and the top suddenly attenuated, with points incurve-hooked; flowers in fascicles; the circular winged fruit eye-lashed on the margin; this arching elm is fond of moist margins of rivers, but will grow in any soil; bears transplanting and pruning freely; timber light, tough, elastic, strong, and durable; growth rapid, and lasting age; thrives well in California from seeds, slips, etc. A national favorite for public and rural adornment.

U–s racemosa—CORKY WHITE ELM. Only varies from preceding in the somewhat corky twigs in youth, and with the buds downy, and fruit racemed; the wood is regarded finer grained and of tougher quality by wheelwrights and wood-workers.

U–s campestris—ENGLISH (*Cork* and *Wych*) ELM. Of Europe, Asia, and Japan. Tree of enormous size, of great age, and valuable quality; is tough, hard, fine-grained, and very durable; next to the best in archery, and for keels, blocks, hubs and wheels, piles and pumps, gun carriages, gunwales, tools, etc., the bast of this and several elms as chair-bottoms.

U–s crassifolia—An EVERGREEN ELM of Texas and Mexico. The *U. parvifolia* is an ASIATIC EVERGREEN ELM.

U–s Floridana—FLORIDA ELM. Tree of forty feet.

U–s fulva—SLIPPERY ELM. Of moderate size; rarely over two feet in diameter; leaves thicker and rougher, more bluntly toothed, the feather veins hairy, prominent beneath, apter to be branched towards the edge; the upper surface rough both ways; the seed broader and more perfectly circular; bark sweet, nutritious, and slippery; very valuable in innumerable ways; wood large-hearted, flesh-colored, most useful, and durable.

U–s alata (racemosa?)—WINGED ELM or WAHOO. Chiefly of the South and West United States; thirty to forty feet; bud scales and branchlets nearly smooth; smaller branches mostly corky-winged; wood fine-grained, heavier, and stronger than the *White Elm*. Said not to be equal to the European (?), celebrated both for strength, durability, and beauty; exceedingly hard and strong for machinery, tackle-blocks, and farm implements.

U–s Mexicana—MEXICAN ELM. Tree sixty feet or eighty; a quick growing avenue tree.

U–s pedunculata. Of Middle Europe and Asia, for avenues.

U–s Wallachiana—HIMALAYAN ELM. Three thousand to ten thousand feet altitude; grows up to seventy feet; a deciduous species.

PLANER-TREES.

Planera.

Trees allied to Elms; leaves smaller, flowers in axillary clusters, yet the rough nut-like fruit has the seed of Buckthorn; flourishes in rich lowlands or swamps; wood aromatic.

Planera Japonica—JAPANESE PLANER-TREE. This is considered one of the best timber trees of Japan.

P–a aquatica.—Growing in sub-swamps and along wet banks of streams from Kentucky southward; nearly smooth; the small leaves oblong-egg-form; fruit stalked in the cup, beset with irregular projections.

P–a Richardi.—Between Black and Caspian Sea; trunk like a beach; lofty, richly tufted, rapid growth, shining foliage; no insect ever infests; wood of great value, extremely beautiful; heavy, hard, fine grain and polish; more durable than oak.

HACKBERRY, SUGARBERRY, OR NETTLE-TREE (*Celtis*). These are chiefly large shrub trees, of strikingly neat and elegant appearance; the foliage is rich and abundant, but more emotional, though in general aspect like elms; fruit like bird-cherries, from the axils of leaves, the pulpy coat over the stone thin, in color brownish, or to purple and black; of sugary sweetness.

Celtis occidentalis—NETTLE-TREE, SUGARBERRY, HACKBERRY. From a bush to a tree of fifty to eighty feet high and several feet in diameter, with varieties not sufficiently distinct for species; the wood is exceedingly close, fine, satin-grained, tough, and elastic; splits remarkably free, noted for its rapidity of growth, but exposed soon decays; used for baskets, bottoms of chairs, etc.

C–s Australis—LOTUS-TREE. Of south Europe and north Africa; of longevity; to fifty feet high; available for avenues; berries edible; wood hard and dense—admirable for turning and for similar uses.

FAMILY MORACEÆ.

Of the Mulberry (*Morus*).

FIG FAMILY.

Middle-sized trees of milky sap, with rather large rounded, or heart-shaped and alternate leaves, simple or lobed; the texture tender. Flowers, male and female, on the same or separate trees, in tags from the forks or axils of the leaves, the fertile becoming compound cluster berried, like *Blackberries*. Their foliage, the favorite food of *Silkworms* (*e. g. Bombyx mori*). This division includes Banyan tree or vast Indian fig (*Ficus Indica*), also *F. religiosa*, *F. elastica* of California culture; India rubber tree.

Morus rubra.—RED MULBERRY. Tree thirty to seventy feet high and one to two in diameter, with a thickly branched and rounded head, casting a deep shadow; fruit, dark purple or nearly black, of agreeable flavor, both fresh and in cookery. The wood is very hard, strong, and lasting, in demand as light timbers for ships, for treenails, and for posts, and railroad uses; mostly throughout United States on rich alluvial soils.

M–s nigra—BLACK MULBERRY. Of South Russia and Persia; highly valuable for its pleasant refreshing fruit; cultivated from ancient times for ornament and for shade, its age marked by centuries; is very hardy, thrives

well in California, leaves also used for silkmoths; tree unisexual. *M. atropurpurea*, from Cochin-China, is allied to it; the cylindrical fruit-spike two inches long.

M–s alba—WHITE MULBERRY. Of China. A tree of low stature—as usually dwarfed—but abandoned attains to forty feet or so. The best food is of trees set in spaces of twelve by fifteen or twenty. With its manifold varieties yields the best food for silkworms, is of extremely easy culture from cuttings in sweet soil free from stagnant moisture. Being cultivated for the last four or five thousand years with the silk industry of Asia, like objects of similar rural care, very many varieties have arisen. Among these may be mentioned the *M. Indica*—macrophylla—*multicaulis*, *morettiana*, *chinensis*, *latifolia*, *Italica*, *Japonica*, *Byzantina*, *nervosa*, *pumila*, *tortuosa*, the Constantinople, *tartarica*, *pabularia*. Some have palatable fruits, as those of *Belloochistan* and Afghanistan. All of which are only choice forms of one and the same species.

As general remarks, it may be stated that the ROSE-LEAVED (Covennes) variety of *alba* is a free grower, yields largely of rather thick leaves, from which silk of a heavy and excellent quality is obtained; thrives best on rich dry slopes.

The *Bushy Indian* variety (*M. Indica* above) has beautiful flat long-pointed green leaves in abundance, but light; can cut three or four times or more a year; has fine aroma, and is greatly relished by all worms, though all may not thrive equally well upon it. This requires rich low bottoms; of amazing thrift at the shortest notice; fruit black.

The North Chinese (*Chinensis* above) has heart-shaped, flat, thickish leaves of good quality. For use in the earliest stages *Cape* and *Morettiana* do; manilla varieties, *multicauli*, weeks earlier.

M. celtidifolia, of Mexico and Peru, at seven thousand feet; fruit edible.

M. insignis, of New Granada, is a similar species.

Broussonetia papyrifera, called PAPER MULBERRY, from its resemblance; only noted because the bast makes very strong paper, and may be utilized as a textile fabric covered with linseed oil for a water-proof; is also very light; will thrive well here; is an ornamental shrub or small tree; is of no value for either its leaves or wood. From the isles of the Pacific, China, and Japan; makes fine crates for oranges, etc. If for subordinate uses it is best cultivated in the copse, like osiers.

Maclura aurantiaca—OSAGE ORANGE. This is a most beautiful, low, round-headed tree, as grown in the south Atlantic, United States, and west of the Mississippi; has the charm and splendor of an orange tree, and, as we have seen it, of equal size, and, if possible, greater symmetry; grows, however, to sixty feet. In California, hitherto, only used as a Summer-green hedge. The wood satiny-yellowish, very elastic, strong, and durable, polishes like steel, and is nearly as elastic. The best thills, tongues, and felloes of carriages, and bows for archery are made of it; hence known as "Bow de arc" tree, or bowwood. Silkworms may be fed on it, but it proves inferior to the mulberry; easily propagated by seed, by layers, and by cuttings from the roots. It is surprising that such valuable timber, for so many purposes, is not more cultivated. Fruit large as an orange, finely tesselated surface, like a pineapple, of light lemon yellow-greenish color; leaves, like a white mulberry. The horrent thorns stand guard against its use, if the silk and worm were not impoverished thereby.

Maclura tinctoria—FUSTIC OR YELLOW-WOOD. Yields a yellow dye and pleasant fruit; the wood of great value; a tree of the West Indies. All the *Morads* are trees of rapid growth and almost imperishable wood; mummy-cases of many thousands of years supposed to be made of them; the bark

of all abound in fine fibers like the best flax, and hence, valuable for cordage and paper making, etc.

Laurelia aromatica—AROMATIC PLUME-NUTMEG-TREE. A colossal tree of Southern Chili; in Valdivia the principal one used for flooring; the timber never bored by insects; well adapted also to exposure to the weather. (Dr. Philippi in Baron F. Von Mueller's Catalogue of "Forest Culture.") Noted for its close alliance to mulberries.

Brachychiton acerifolium—MAPLE-LEAFED FLAME TREE. An evergreen shade tree with magnificent trusses of crimson blossoms, like *B. pulneum;* suited to promenade lines, and yields a kind of tragacanth gum.

CINNAMON FAMILY.

LAURELS (the LAURACEÆ) *Laurus.*

Are generally trees of considerable size; somewhat distinguished by mostly alternate leaves; flowers clustered, inconspicuous, or without petals; stamens, about nine (six outer and three inner, their anthers for the most part valved inwards); ovule, pendulous, never erect; stone-fruited, on a thickened base; aromatic, abounding in fat, or both fixed and volatile oils with camphor; in quality they closely resemble Nutmegs. Extensive order. Trees of great beauty and eminent use; only a few of little note.

Laurus nobilis—The NOBLE LAUREL of Asia Minor. Leaves in great request for various condiments, confectionery, etc.; will grow in California. Mr. Klee, gardener of State University, has it flourishing at Berkeley. The peculiar aroma of these Bay leaves cannot be replaced, unless perhaps by *Lindera benzoin*, *Persea Teneriffæ*, of Mad'n, Azores, and Canary Islands, etc.; a magnificent tree, mahogany-like wood, hard, and beautiful for fine furniture and turnery. One of the most hardy trees of this large order, *Laurinæ.*

L-s benzoin—SPICE BUSH, WILD ALLSPICE, FEVER BUSH, etc., also as *Benzoin odoriferum.* A shrub eight to ten feet; in damp woods; leaves, obovate, pale beneath, two to four inches long and one to two wide and shortly sharpened; fruit, small as bird cherries, dark purple; smooth branches; brittle; spicy odor and pungent flavor. Common in United States.

Benzoin melissafolium—BALM-LEAF BENZOIN. Lowlands of Virginia southward; branches, soft and hairy; the oblong leaves blunt or heart-form at base and downy beneath; flowers of the umbels few.

L-s sassafras (SASSAFRAS *officinale*)—SASSAFRAS. Tree, forty to fifty feet high by one half to three in diameter; often only a bush ten to fifteen feet high; frequent in woods and fence rows; in age horizontally branching, broadly flat topped; the large leaves entire or variously lobed, of soft, yellow-green luxuriance; fruit, pale ultramarine blue; bark, an aromatic stimulant of highly esteemed medical virtue; timber, reputed secure preventive of vermin and insect pests in cabinets, etc.; is light, stiff, and durable; leaves and pith of the twigs abound in a delicate mucilage, useful for various purposes. The fragrant and agreeably spicy taste of the bark, especially of the root, is used as a tea, and for flavoring rural Spring beers. Singularly ornamental.

Umbellularia Californica—CALIFORNIA LAUREL, BAY TREE, etc. As coast tree of the Pacific, fifty to one hundred feet or more, two to eight feet in diameter, timber very tough, elastic, and takes fine polish; a remarkably beautiful evergreen, of erect growth while young, in age becoming arched and pendulous; in rich, moderately moist localities, of free growth; the

interior and alpine forms more shrubby; kernels yield tallow, leaves used as spice.

Cinnamomum Camphora—CAMPHOR TREE. Of China and Japan. A beautiful yellowish-green ever vernal tree, of rapid growth on the coast; attains to forty feet; uninjured by frosts, beautiful for rural adornment; the wood and all parts abound with camphor, hence not infested with insects. Mr. Klee, gardener of the Berkeley University grounds, will take pleasure in pointing the enterprising inquirer to a finely flourishing tree in the open groves there.

Camphora officinarum—CHINESE CAMPHOR TREE. *Oreodaphne opifera*, of South America; yields a camphor product, and very many others.

Tetranthera (umbellularia) *Roxburgii.*—Yields fatty matter similar to our native BAY TREE.

T-a calophylla—The JAVA TALLOW TREE *(cyclodaphne sebifera B.)* From the kernels of the berries a tallow-like fat is pressed for making candles; the yield is said to be large.

As the laurels and camphoraceous trees consist of between fifty and a hundred genera, besides a vast number of species and varieties, suffice to say in a general way they exhale this camphor-laden sphere repellant alike to noisome insect pest—as most mixed woods are wont in their degree—sentineled over the tender, non-resistant fruit tree, but are also salutary natural guards lest the "plague come nigh thy dwelling."

Cinnamomum cassia—SOUTH CHINA CINNAMON TREE. The Chinese cinnamon or "cassia lignea" is from *C. obtusifolium, C. panciflorum, and C. tamala*, up to six thousand or eight thousand feet; will grow in California; the root also yields camphor.

LINDEN FAMILY.

Tiliaceæ.

This forestal family includes nearly forty genera, chiefly large umbrageous trees, with tough fibers of the inner bark, and light soft wood, devoted to many important uses. In general the prevailing foliage is heart-shaped, but the most distinguishing feature is the main flower stem of the cyme, cluster, being kneed or bent where it coheres with the mid-rib of a thin-narrow, leaf-like bract, and thence winged to the base, the upper half free.

Tilia Americana—AMERICAN LINDEN, BASSWOOD. A tall rather conic tree, of striking regularity of its numerous horizontal branches, with ample obliquely heart-form foliage, notable as affording a deep mass of dense shade, turning to a gay lemon yellow in Autumn; flowers numerous, creamy whitish, very fragrant, and the honey bearing lure of bees; tiny fruit size of a pea, and bony nut like, with a single stone. The wood is soft, whitish, of fine close grain, coherent and pliable, in request for coaches, cabinet, and inner carpenter work, also for hollow wares, carvers, and affords the very best coal for gunpowder; and being highly ornamental, is a favorite rural shade and shelter tree. Propagated by seed, or multiplied more rapidly by cutting an old tree close to the ground and covering the stump with earth, they forthwith shoot up as elms and the like, with great vigor, and the suckers have soon rooted and ready to transplant.

T-a Argentea—SILVER LIME TREE. Of Southeast Europe. The wood of this is not attacked by boring insects. The flowers deliciously fragrant, and yield on distillation a precious oil.

T-a Europea. A favorite round topped rural tree of Europe, hence

EUROPEAN LINDEN; justly admired for its venerable antiquity, fine form, fragrance of flower, and beauty of foliage; the broad blade on long and slender leaf stems like the aspen, which gives ease, and as it were, living grace of motion is heart-form, yet there is coquettish obliquity enough to vary the formal, with considerable extenuation of the tip; as age impends, the ponderous boughs take on a curtain-fall tendency of sober grace and becoming dignity; then, full oft the central head is wont to become twiggy, thickened—is hence the high sylvan home of the song bird, and secure retreat against birds of rapine and beasts of prey.

Lindens and basst-woods (ancient *tiel trees*) are celebrated for light, soft, white wood, most even grain, and best ordinary wood for the carver and musical sounding boards, not liable to split.

WILLOW-WORTS.

Salicaceæ.

Comprise two genera, or POPLARS and WILLOWS. Both have male flowers on *different trees*, while nearly all the other *Amentifers*, or catkin-bearers, are from different buds on the *same tree*. The seed chambers of both are leathery, one celled, two to four valved, small, and the minute cottony seeds, with long silky hairs, from the base.

Poplars (people's trees) consist of twenty or more kinds. These cottonwoods, like the willows, usually grow by little watercourses, or by the banks of larger streams; their male flowers in long catkins—these are the pretty tagtail tassels that grace the twigs of Spring; their leaf stems mostly flattened laterally, or expanded vertically, near the broad blade, hence their tremulous or rocking motion; stamens apt to be very numerous.

Populus grandidentata—BIG TOOTH-LEAFED POPLAR. Tree forty to fifty feet high, by two through; leaves nearly circular, dimensions two to four inches; noted for the few large and unequally-toothed margin, and for the fertile flowers being inconspicuous; both tags and fruit very small; the two to four-inch leaf stalk is flattened sidewise near the base of the blade; buds conical; found native in the mountains of Carolina and Georgia of the United States, and North; wood soft, formerly for "chip hats," before the palm-leaf Summer hat era.

P–s angulata—ANGLED COTTONWOOD. A large tree, fifty to eighty feet, by two to three in diameter; young branches sharply angled; leaves somewhat heart-shaped, point attenuated, margin hook-toothed; the young leaves of sprouts very large (seven inches or so), and strongly heart-like. Seacoasts of southeast United States, along rivers; (the *nigra* of *Walter*, and *angulosa* of Michaux).

P–s heterophylla—VARIABLE, OR DOWNY-LEAFED POPLAR. Tree sixty to eighty feet, by two to three; branchlets not angled; male flowers of fifteen to twenty stamens; leaf stem nearly round; of southeast United States, middle and upper Carolina, and Georgia.

P–s Fremonti—FREMONT'S POPLAR. A large tree, fifty to one hundred feet high; by banks of streams and rich bottoms; from the Pacific of Upper Sacramento to Nevada, Utah, Colorado Valley, and Southern California to Rio Grande. Leaves, kidney-form, with broad sharp point, slightly bayed at base, its leaf-stalk latterly flattened, few coarse teeth on the margin; scales of long tags, with sixty or more stamens; fruit-pods, three-valved, very thick and leathery; seeds, white. The Southern California variety, *Wislizeni*, has the leaves a little wedged at base; fruit pods a little angled, and often valved on long, rather slender, fruit stemlets. As the

logs are four to six feet through, the lumber is in the market for lighter protected uses.

P–s monilifera—NECK–LACE POPLAR. A tree of eighty feet, the young branches a little angled; leaves, heart-shaped or blunt at the base, taper-pointed, long leaf-stem, a little compressed; scales of the male flowers torn-fringed but not hairy; this is the *Bead-fruited Cottonwood* (*P. Canadensis* of Michaux, and *levigata* of Wild.), the best COTTONWOOD for speedy timber.

P–s trichocarpa—PACIFIC HAIRY–POD POPLAR. A tree sixty to one hundred feet high by three to six through, branches somewhat angular, and, like the buds, varnished-viscid, heart-trianguloid leaves, on rounded stem, variable; often broad egg-shaped of two to four inches dimensions. Perhaps best popularly distinguished by being *rusty underneath*—tiny pods, densely soft, hairy, and three to four-valved. *P. Balsamifera* variety, Hook variety, *Californica*, Watson, Santa Clara R., California to Oregon, Washington Territory, British Columbia, etc. Being sparsely distributed, little as marketable lumber is used for furniture, staves, and for butter boxes, etc.

Poplars, like Willows, should line our rills and runs, gullies and deeper gulches, at the risk of seedy nuisance, for the sake of staving hideous wash-outs and intercepting field and forest fires. WHITE P., *P. tremula*, E. ASPEN, and native *tremuloides*, N. A. ASPEN, and *P. Nigra* Black, are all good.

WILLOWS are trees, shrubs, or undershrubs, mostly near water; twigs rounded, buds covered with only one scale; leaves usually long, relatively narrow and feather-veined.

Salix Babylonica—WEEPING WILLOW. From west Asia to as far as Japan. For ornament, and for consolidating river banks.

S–x sessilifolia—CALIFORNIA GRAY WILLOW. The narrow silvery leaves sitting close down upon the twigs; an ornamental foreground bush, or sometimes tree, to ten inches or more in diameter; the soft, hoary pubescence particularly pleasing; the variety *Hindsiana* of finest foliage; along the coast range of the Pacific, from Santa Rosa to Ukiah; also Sacramento valley.

S–x caprea—THE BRITISH SALLOW, PALM, or HEDGE WILLOW. Among the earliest willows—in blossom so soon as Palm Sunday; wood useful for handles of sundry implements, and bark for tanning.

S–x cordata—HEART–LEAF WILLOW. One of United States osiers, the leaves oblong, lance-pointed, heart-shaped only at base, with sharp teeth, smooth above, paler beneath; stipuled appendages broad and leaf-stem conspicuously winged, like the feet of Mercury; along inundated banks and low meadows; of several varieties; common variety *rigida*, larger, six to fifteen feet, leaves four to eight inches long, fruiting catkins a half less, and leafy at base; seed vessels smooth and set high on thready stems; male flowers of only two stamens. In California sub-alpine.

S–x viminalis—BASKET OZIER. From Europe and north Asia; one of the best for basket work; suited to rich, moist meadows; when cut down shoots up sprouts ten to twelve feet; fine for withe bands or hoops and wicker work; grows to thirty feet; leaves long, line-like, and taper-pointed, white-satiny beneath. Smith's variety is the best. A similar native, tough-twigged willow, *S. Austinæ*, of Sierra and Mono valleys, favorite of our Indian basket workers.

S–x fragilis—BRITTLE or CRACK–WILLOW. A large European tree to ninety feet, contains more tannin than oak, and more salacin (a substitute for quinine) than most other willows, besides, the timber is light, tough, and elastic; var. *Russelliana* is cultivated for basket work.

S–x lucida—SHINING WILLOW. A beautiful native *osier*, a shrub or small

bushy tree; leaves usually narrowly lanced, shining on both sides; stamens or male-threads mostly five; common along overflowed banks of streams.

S-x rubra—RED WILLOW. Of Europe, Western Asia, and Northern Africa; chosen for osier beds, as cut down it shoots eight feet or more in a single season.

S-x triandra L. (S. amygdalina L.) ALMOND WILLOW. In Europe and Asia; for white basket work, being both pliant, tough, and durable; tree thirty feet, shoots nine feet or more.

S-x daphnoides—DAPHNE OR LEATHERWOOD-LIKE WILLOW. Middle Europe and Northern Asia; tree of great rapidity of growth.

S-x lanceolata—LANCE-LEAF WILLOW. One of the basket willows of Britain.

S-x purpurea—PURPLE WILLOW, of wide range in Europe and Western Asia; one of the osiers. There are between one and two hundred species of willows to select from, besides a vast number of varieties; all of easy culture from cuttings. The GOLDEN OSIER (*S. vitelina*) is one of these varieties, viz.: from *S. alba;* the shoots used for hoops and wicker work. As an ornamental tree the terminal branch twigs pend gracefully and are of greenish golden hue, or smooth and yellow.

Combretum butyraceum—BUTTER TREE. Of Southeast Africa. The butter fat of the fruit has a delicate, spicy flavor; would flourish in the hottest sheltered parts of Southern California.

Pittisporum undulatum. A common tree of Illiwarra, New South Wales, near Sidney; suitable for wood engraving.

Diospyros ebeneus—EBONY. Up to five thousand in Ceylon; furnishes the best ebony wood. Most other kinds could be introduced into California. *D. melanoxylon*, *D. kaki*, *D. Ebenaster*, *mabolo*, *tormentosa*, *roylei*, for their black timber, if not fruit. The "KAU APPLE" of South Africa another.

D-s Lotus—DATE PLUM. From North China to Caucasus; like black cherries; wood like *D. chloroxylon*. Often known as *Green Ebony*, but not to be confounded with *Excœcaria*, *Nectandra*, and *Jacaranda*.

D-s Virginiana—PERSIMMON, or native *Date Plum*. A conic deciduous tree, thirty to forty feet high, a foot or so in diameter. Timber very tough, lasting, and elastic; fruit size of a plum; golden, ruddy, honied pulp, soft texture, and glaucous hue; delicious after late frosts. Improved by culture.

All the EBONY FAMILY have wood that finishes finely, and closely resembles the Satinwood of India.

Maba geminata is one of the Ebony trees of Queensland; black towards the heart, and bright red towards the bark; close-grained, hard, heavy, elastic, and tough; takes high polish, and is fine for veneers.

M. fasciculosa, the outer wood white and pink; good substitutes for ebony.

Embothrium coccineum—"NOTRA OR CIRUELILLO" of Chili; from thence to south, and of Magellan. A tree of exquisite beauty; seldom over thirty feet high; wood utilized for furniture. One also equally gorgeous of the Peruvian Andes, the *E. emarginatum*. Also *E. Wickhami* of North Queensland, the allied *Stenocarpus sinuatus*—Eastern Australian.

Eucryphia cordifolio—Muermo, or Ulmo, of Chili. Magnificent evergreen tree over one hundred by six feet diameter; flowers favorite of bees. In Chili the wood preferred for oars and rudders.

Eugenia cordifolia—HEART-LEAF MYRTLEBLOOM. Ceylon, up to three thousand; fruit an inch diameter. *E. maboides*, seven thousand; fruit size of a cherry. *E. Hallii*, Quito; fruit of large size.

E–a maboides—Ceylon, up to seven thousand elevation; fruit size of a small cherry.

E–a malaccensis—The large ROSE APPLE of India. Although tropical may suit some southern forests; leaves a foot long; large fruit of rose odor, wholesome and agreeable taste.

E–a myrtifolia—East Australia. Handsome bush with palatable fruit.

Fraxinus Oregana—OREGON ASH. California and Oregon; tree from fifty to one hundred feet; timber similar to white ash of the East; damp, stiff, rich soils of ravines, swamp, and river margins; in high request.

F–s Chinensis—CHINA ASH. On which a peculiar wax is produced by *coccus pela*; forty thousand pounds annually exported. *F–s Americana*—WHITE ASH, *F. pubescens*—RED ASH, *F–s viridis*—the GREEN ASH, *F. sambucifolia*—BLACK, or SWAMP ASH, *F. quadrangulata*—the BLUE ASH, *F. platycarpa*—CAROLINA, or WATER ASH, are all of inestimable value. In the ornamental ornus section *F. dipetala* and *F. ornus* are the best for promenade trees; well known for use and beauty. *F. excelsior* not only yields manna but like most, the bark is medicinal; being allied to the olive would doubtless make good stock to graft the olive and the *Fringe Tree*, and the lilac upon, all febrifuges of celebrity apart from combined beauty of ornament unequaled!

Magnolias are mostly trees of noble aspect, striking foliage, and large, fragrant flowers, three shedding sepals of the cup; petals six to twelve in concentric series; cone-like fruit, from which the ripe seeds hang by fleshy threads, etc. Usual floral season from April to August.

Magnolia grandiflora—GREAT LAUREL MAGNOLIA. A magnificent evergreen tree, sixty to eighty feet by two to five; clear, clean shaft and semi-elliptical or pyramidal head, clad in large, brilliant white flowers that tip the young branches; they brown with the slightest bruise or scratch; hence, the courteous are wont to write their "Rosalind" upon the exquisitely fragrant and delicate petals; in California, flowers more or less the whole year round; thrives best on rich light soil; native of the South Atlantic and Gulf, United States.

M–a glauca—LITTLE SEA-GREEN LAUREL MAGNOLIA. This delightful little tree is a hardy favorite, the most fragrant of all the species, fifteen to thirty feet high—rarely forty to sixty—symmetrically conic and densely branched, bark whitish, evergreen leaves elliptical, about three by two inches, showing green above and softly gray-greenish, or even satiny-whitish beneath; flowers white, petals nine to twelve, two to three or four inches across; aroma strong, may be scented from afar. Delights in swamps, thrives by springs and streams, and will grow well on moderately dry soils, but then the flowers more fugacious. Also known as *Swamp Sassafras* and *Beaver–Tree*.

M–a acuminata—CUCUMBER MAGNOLIA. A tree of tropical verdure of the mountains of South United States and throughout the Middle, and valleys of the West, where it grows to sixty or ninety feet high, clean trunk, two to four in diameter. Leaves broad-oval, lance attenuate-pointed, soft silky beneath, the flower leaves egg-form, gray yellowish-greenish hue, or tinged with blueing; cylindrical fruit, two to three inches long, somewhat like a cucumber; hence, "CUCUMBER–TREE." Found in rich forests from West New York and Pennsylvania to Ohio and South.

M–a macrophylla—GREAT-LEAF MAGNOLIA. A small tree, thirty to forty feet high, often much less; branches fragile and weak, sheltered by other forest trees; bark pale Russia-leather to white; leaves very large, to nearly three feet long by ten inches wide, ob-egg form, sharp pointed, but narrowing back to a heart base; pale-greenish beneath, or silky and silvery.

Flower petals white, purple tinged inside at base; four to five inches long, of egg form; fragrant. Mountains of North Carolina, Kentucky, and Tennessee. Flowers eight to ten inches broad. In rich sheltered woodlands.

M–a umbrella—UMBRELLA TREE. A small Summer-green tree, twenty to thirty-five feet high, with a few irregular branches, but simple, of fifteen to twenty feet. The body is weak, rarely over three inches in diameter. Leaves very large, from one and a half to two feet long and six to ten inches broad, crowded at the summit all around like an umbrella. Outline similar to the above. Throughout the far southeastern United States. Flowers seven to eight inches broad. In rich half-shady woods.

M–a cordata—HEART-LEAF MAGNOLIA. Tree forty to fifty feet, usually twenty-four to forty. Leaves four to six inches, by three to five; flower cup small; petals oblong-lanced, yellowish, faintly streaked with red, three inches long. Carolina and Georgia.

M–a Yulan. Of China; fifty feet.

M–a Campbelli. Of the Himalayas; one hundred and fifty feet high. Flowers nearly a foot across.

Drimys Winteri—WINTER'S BARK (Chilian *Canelo*—BOIGHE of the natives). A tree of sixty feet; wood never attacked by insects.

Liriodendron tulipifera—TULIP TREE. A most beautiful tree; over one hundred and fifty feet high, eight to nine in diameter; colossal columnar. Soft, smooth foliage like some maples, as if abruptly cut off at the end. Flowers like tulips, two inches or so broad, greenish-yellow streaked with orange. Of the richest bottom lands of the United States. Soft timber, very valuable as a substitute for white pine in carpentery, joinery, outdoor, and inside work for coach panels, as it never nail-splits; also, bowls and hollowware. Is light, works well to the curve of stairways, and is strong; makes fine cylinders and wheels for mechanics, or post and rail of rural use. These magnolias are magnificent trees of tropical verdure. To beauty they add balm, giving grandeur and glory to forest and glen.

Leucadendron argenteum.—SILVER TREE. South Africa. For splendor—the Protead *Stenocarpus sinuosus*, the most brilliant crimson of all the tribe; *Metrosideros florida*, the Scarlet Ratas of New Zealand; *M. robusta*, eighty feet high; *M. tomentosa*, forty feet. On the coast where the native *Rhododendron* flourishes, *R. Falconeri*, fifty feet. The great *Melaleuca leucadendron* or CAJUPUT TREE of Asia grows to one hundred feet (true cajuput oil tree).

Liquidamber styraciflua.—SWEET GUM TREE (*American Storax*). Colossal stem six to ten feet diameter, and one hundred feet or more; wood fine-grained, balsamic juice; hardens to resin of benzoin odor.

L–r altingia.—STORAX TREE. Of Red Sea, India, and *New Guinea*; at three thousand feet; one hundred and fifty to two hundred feet high; wood heavy, very close-grained, and extremely fragrant; yields the *liquid storax.*

Ilex aquifolium.—EUROPEAN HOLLY. An ornamental evergreen; to sixty feet. Although thriving here hollies are of slow growth.

I–x opaca.—AMERICAN HOLLY. Symmetrically conic tree thirty to forty feet high; prickly-margined leaves smooth and shining; berries lighter red than the English, and to our eye, a handsomer tree. The wood of both close satiny white; sap almost ivory hard; takes a fine polish; used by engravers, and for inlaid cabinet work, for turnery, and by screw and whip-makers, etc. United States, east and south.

Ficus columnaris—BANYAN TREE of Lord Howe's Island. Not tropical; one of the most magnificent productions of the whole vegetable kingdom. As it were, a vast sylvan temple, the pillared dome of dark evergreen foliage resting on stems so alike none can say whence the banyan cometh nor

whither it goeth. In warm and sheltered humid tracts of Southern California coast, or some choice island nook, this almost boundless bower might become another world's wonder. Whether it yields caoutchouc, like most figs, is still untested. But as to its being one of the grandest ornaments in the world no one will question.

F–s cunninghami—CUNNINGHAM'S FIG. East Queensland. A tree of monstrous growth, the large spreading branches sending down rooting stems like the banyan; body twelve feet or more through; the sweep of root base forming wall-like abutments; some extend twenty feet from the tree; in the large crevices of the trunk several could conceal themselves; yields caoutchouc.

F–s colossea. COLOSSAL FIG is still more gigantic, though not so hardy.

F–s elastica—INDIA RUBBER TREE. Upper India. Looks thrifty in California; a large tree; milky sap concretes to caoutchouc and also *F–s laccifera* or MILKY FIG from Silhet is another, and that this and *elastica* yield most in a ferruginous clay soil on a rocky substratum; both bear dryness, but like shade in youth. Out of six hundred species, and some from cool mountain regions, it would be strange if some would not tolerate our clime well, although most are tenderly promising.

F–s rubiginosa. Of New South Wales, is one of the hardiest; makes an excellent evergreen shade.

F–s carica—FIG. In its native state is small and of inferior quality. A wonderfully reproductive, prolific, and profitable tree, even bearing the first year from cuttings to half a century or more, and not one but several crops in a season—in its prime, in the short space of five years. Planting a less number of trees than the fingers of one's hand would suffice for the ordinary support of a family for a lifetime in this land of the olive, vine, and fig tree, with none to make afraid! Is not this neglect then a marvel of prodigality, if devoting a few months—say the brief time of penning this note—with future care and due providence; yet so few of us manifest forethought and enterprise enough, each citizen morally or religiously to plant some noble tree of honor, of fruitful renown, and of profit or general use, a testimonial to the ages following! Granted such a boon, who could picture our beautiful and bountiful Pacific of the future? Japan of the setting sun!

As an export article, only the white is deemed available. At La Paz, a variety, the first crop blue or black, the second white—both delicious and highly valued; also, some plantations in Lower California are already noted for the excellence of their figs. The black or purple mission fig is a fine fresh table fig, of more general thrift. Prof. G. Eisen, of Fresno, issued a pamphlet on "Fig Culture and Curing," of great value, in which he says the best conditions suitable for figs are: *First*—A moist soil of light sandy-loam before beginning to ripen, but later drier, with perfect drainage at all times. *Second*—Sufficient heat, sun, and air, to insure sweetness. *Third*—Absence of frost, or a lower temperature than 18° Fahr.; albeit, they can bear 12° if tolerably dormant. *Fourth*—No heavy rains while ripening, and alike shielded from heavy dews in drying.

In the most favored Smyrna districts, Summer seldom exceeds 90° to 100° Fahr. in the shade, 130° to 140° in the sun; freezing in Winter is seldom more than half a dozen degrees. A heavier frost is not considered injurious, or in any way influencing the quality of the fig crop.

Where the best of *Figs* have been cultivated as a staple crop for thousands of years—perhaps even the people of the Pacific might learn something—in any event it is well to know that in the Aidin district of Asia Minor fig trees are always set two in the same hole (spaced twenty-five to

thirty feet distant, according to soil, the poorer the better, in March), put a foot apart, then joined at the top, and here made to cross each other like the letter X, a few inches above the ground. At this junction they are tied to each other, and to a stake, to keep steady; both trees allowed to grow and develop into one tree, the stems being wound one around the other, like a twining vine around a pole; is the object to prevent self-fertilization, and so, as it were, hybridize by the pollen of another tree, thus in connubial proximity? These cuttings, taken at different times of the year, although from the same parent tree, have more male flowers in the first crop than later on. Figs, like nut-producing trees, must be sparingly, if at all, pruned. Of the six hundred varieties of figs it is probable many would flourish finely in California. Of these the Australian *F. colossea*, *F. altissima*, and *F. Australis*, are promising, besides the Egyptian *F. sycamorus*, of whose imperishable wood ancient mummy cases are presumed to have been made, and the Brazilian *F. anthelmintica.*

Hernandia Sonora—THE DEPILATORY TREE. A Daphnad, or allied to moosewood. The leaves chewed and applied to any hairy part, "it destroys the hair without pain."

Dirca occidentalis—WESTERN MOOSE OR LEATHER WOOD of California. Tremendously tough bark, and extraordinarily light, white wood—like Mezereon bark—acrid, and the bark of the root even more so; blistering; medicinal; would make a superior quality of paper, etc.

Pterocarpus Indicus—LINGO. China and India. A tree of considerable dimensions, famed for its flame-red wood; furnishes a kind of dragon-blood resin. Leguminous.

P–s marsupium—RED SANDAL-WOOD. Sheltered and free from frosts would thrive here; yields the best kino. Mountains of India.

Liquidamber orientalis—ORIENTAL LIQUID–AMBER. All these storax species are tall trees yielding balsam. This, from Asia Minor, furnishes a vanilla-scented liquid storax, used as a perfume to scent tobacco in cigars, and to keep moths from clothing, etc.; abounds in Cumarin.

L–r styraciflua—SWEET GUM TREE. A large and beautiful tree of United States, seventy to eighty feet high by two to four; alternate leaves roundish, palm-form, the starry radiating lobes attenuate-pointed and toothed, similar to the *Vine Maple*, but fewer divisions; when bruised or torn very fragrant; tree exudes a kind of gum-resin storax, pleasantly aromatic; wood soft, fine-grained, and suited for interior carpenter and cabinet work, bowls, and other woodenwares; thrives best in rich alluvial bottoms and river swamps.

Loptospermum lævigatum—SANDSTAY SHRUB, or tree. One of the most effectual of all for arresting the progress of drift-sand in a dry clime like ours; seed scattered in Autumnal first rains on the sand and loosely covering with boughs *pro tem.*

Ligustrum Japonicum—JAPAN PRIVET. A sub-evergreen shrub; grows as readily from cuttings as the common *European Privet*, and a like valuable hedge plant.

Lippia citriodora—CITRON–SCENTED LIPPIA. An evergreen shrub of Peru, Chili, and Brazil; yields scented oil; thrives in California.

Although MUSADS—*Plantains* and *Bananas*—are tropical natives, still they will thrive in Japan, Florida, and South Carolina. Some will even *grow* out of doors in the cold clime of the vicinity of San Francisco with slight protection from the northwest. As foliage displays, their gigantic leaves are among the most striking objects of the vegetable kingdom, and for food fruits unrivaled. Some of the finest muslins of India are made of

their fibers *(M. textiles)*. Young shoots eaten as a delicacy; also, juice of fruit and stem as medicine, dye, and essential oils, etc.

Musa Cavendishii—Lambert; (the *M. regia*—Rumph., and *M. Chinensis*—Sweet—CHINESE BANANA. A dwarf of five or six feet, of robust habit, fitted for exposed localities—reason why so extensively cultivated in the South Sea Islands; yields profusely, two to three hundred fruits in a single spike, and the flavor excellent—greatly improved where it is the most difficult to fruit them at all; this, as also *M. sapientum* and *M. paradisiaca*, ripen their fruit in Madeira and Florida, and a dwarf variety in Mexico, where it is often killed down by frosts, but rallies and comes again; the best with fruit of only the size of a lemon, of such exquisite flavor, and with local demand so great, it never reaches the export market, but commands an almost fabulous price at home.

M. ensete—BRUCE'S BANANA. Mountains of Africa. This magnificent plant attains to thirty feet; leaves twenty feet long by three wide—nearly the largest in the world; but few compound leaves of palms are larger. The inner part of the stem and young spike can be boiled and eaten as a table esculent, but the fruit is pulpless, although the seeds are eaten. As it produces no suckers, requires several years to come into flower and fruit, when it dies off like the sago palm, etc., without reproduction from the root.

M. Livingstoniana. From the same mountains of Safola in Africa; probably need no protection; similar to *ensete*; seeds smaller; found also in Mozambique and Niger regions.

M. paradisiaca. The ordinary grand Plantain or "Pisang," India; among the most prolific of all plants, requiring the least care in climes suited to its growth; stem not spotted; floral or bract-leaves purple inside. In this, the foregoing and the following, suckers are renewed annually from the root to replace the fruit-bearing stem. The fruit of this species is chiefly prepared by cooking; it is thought the varieties have sprung from the wild state of *M. sapientum*. They require a rich and humid soil. Plantain meal is simply the dried pulp ground; palatable, digestible, and nourishing.

M. sapientum—Common "BANANA" or SWEET PLANTAIN. India. One of the most important, delicious, and nutritious fruits; stem spotted; bracts green inside; the leaves, particularly the stalks and the stems of this and other species of *Musa*, can be utilized for yielding a fiber similar to manilla hemp. The golden fruit is usually eaten fresh and unprepared. Of these there are unnumbered varieties. Sometimes in tropical climes one hundred pounds of fruit is obtained annually from a single plant. At Carcas, where the temperature is seldom much above or below 60° F., they are loaded with fruits of more than a foot in length. But this uniformity is possible under the tropics only at about five thousand feet. Proximate success can only be obtained here in favorite sheltered spots. *M. simiarum* far excels in delicacy, and sometimes attains a length of two feet.

M-a troglodytarum L. *(M. uranoscopos*, Rumph.) India, apparently indigenous (?) in the Fiji and other islands of the Pacific. The fruit stalk of this stands upright; edible fruits small reddish or orange. Chinese *M. coccinea*, an ornamental dwarf, has the fruit-spike straight.

PALMS.—Plants of lofty grandeur, the serene crowning glory of the vegetable kingdom; usually of simple columnar stem, with a wonderful magnificence of plaited fan or pen-feathered foliage, not jointed, and flowers well on to the million, fruits to eight thousand even on a single individual. The family combines a perfect world of uses, yet scientifically the most simple; *e. g.*, thick, fleshy, six-parted flowers in spathes; minute embryo remote

from hilum, imbedded in albumen. Of these there are thousands of species of almost every form and habit, and it was thought by Humboldt that there must be an incredible number still to be discovered. They give the most complete tropical aspect to the landscape, and none are more worthy of encouragement than the natives.

Washingtonia filifera—Wendland—WASHINGTON PALM. This California desert palm, under culture by the early Franciscan padres, from the southeastern part of the State, is over sixty feet high, and three feet or more through, with forty feet of clean naked shaft; of this the upper third is fan foliaged, edges lined with bleached fibrous threads, hence the specific name *filifera*, or thread-bearing, the large channeled leaf stalks armed on the edges with hooked horny spines; flowers in June; fruits in September; the fruit branch shooting out beneath the foliaged crown, bends downward ten or twelve feet long, laden with a wealth of clustered dark, skinny, bony berries, about the size of small peas, edible when pounded into coarse flour. Furnishes durable posts, everlasting piles, hat and thatch material, etc. The best specimen of this is seen at Los Angelos in the orchard of Señor J. H. Ramirez, planted about forty years or so ago. They require rather rich moist footing in warm and sheltered locality to thrive well.

Chamærops palmetto—TALL PALMETTO. Of South Atlantic United States, near salt water, preferring a rich damp soil; a palm tree forty to fifty feet high, by one to two feet diameter; the long leaves, five to six feet long, only at the very summit; a tree of the utmost value for submarine and naval structures, for it is probably, in this family only, of all native forest trees, not attacked by the *teredo navalis* or similar marine worms; it seems also absolutely imperishable in salt water; for posts and pickets it never splinters, closing over the ball, unharming and unharmed, and for sea and tide water structures is of incalculable value. The leaves can be utilized for hats, baskets, mats, and many more economical purposes. The great sole terminal bud is deemed a most delicious vegetable luxury, if one can be found who would wantonly kill so noble an object for such a purpose. Forests of these could be profitably cultivated apart from the landscape charm.

C. martiana. Of Nepaul; fifty feet; a noble object.

C. Richieana. Of Afghanistan; has proved hardy even in England.

We have some minor Dwarf Native Palms, as *pumila*, *serrulata*, *hystrix*, etc., but the DWARF PALMETTOS are mostly for ornament; the deep-tinted verdancy of one of these humbler fan-palms is very popular for limited lawns—*C. hystrix* or BLUE PALMETTO. To all intents and purposes stemless, it radiates from a terrestrial crown frond-like leaf-stalks, fan-tipped, three to five inches in length; but those most familiar to the citizen have lost some of their sheltered jungle and wild woodland magic spell—seared and fretted in the public thoroughfares.

C–s excelsa. South China; very desirable, though not tall, as the name implies.

C–s Fortunei—CHUSAN PALM. Twelve feet; leaves for palm-leaf hats; endures frost.

Livistonia Chinensis. A very decorative FAN-PALM of South China and Japan; hardy in most parts of California.

L–a Australis—AUSTRALIAN PALMETTO. A Palm tree of eighty feet high. The young leaves can be plaited as palm hats. This will flourish well in California.

Thrinax parviflora. Of West Indies and Central American sandy coasts. The stem of this *Fan-palm* attains to twenty-five feet; fiber for ropes. *T. argentea* is also closely allied.

Copernicia cerifera—CARNAUBA-WAX PALM of Brazil. A magnificent fan-palm; would doubtless prove hardy here in California; the stem furnishes starch; sap, sugar; fiber of leaves, ropes which resist decay in water; can also be used for mats, hats, baskets, brooms, etc.; inner part of leaf stalks for corks. Mainly valued for its carnauba-wax (shed in scales from the leaves), each yielding about four pounds yearly. Millions of pounds are annually imported into this country. Northern Brazil, in south latitude 29°.

Ceroxylon andicola—NEW GRANADA WAX PALM. Ascends the Andes up to eleven thousand feet; one of the most majestic, and at the same time one of the most hardy of all palms; attains to one hundred and eighty feet in height. The trunk exudes a kind of resinous wax, twenty-five pounds to each stem; mixed with tallow, used as candles. The wax in this species exudes from between the insertion of the leaves. Out of a thousand others there must be many worthy of trial on this coast.

C–n australe. Found on high mountains of Juan Fernandez.

Wallichia oblongifolia—Griffith (*Harina*—Hamilt.) Of the Himalaya as far as 29° north. There one of the hardiest of all palms, not tall, but a graceful and useful object of cultural industry. Several species exist.

Wettinia (Angusta?) of Peru. An alpine palm likely to endure our clime; also *W–a maynensis* of Cordilleras of Peru, and like the foregoing, attains to forty feet, altitude of three thousand or four thousand feet.

The most hardy palms of America of the Amazon region *Geonoma*, *Iriartea deltoidea*, and *I–a ventricosa*, which rises to the lofty magnificence of fully one hundred feet. These and *I–a exorrhiza* and several others ascend the Andes as Amazonian palms to five thousand feet—*Oenocarpus multicaulis* to four thousand—so distinctively named as six to ten stems spring from the same root, each fifteen to thirty feet high; of *Euterpe* two species up to six thousand feet; two or three species of superb palms yield the well known *vegetable ivory*, viz.: *Phytelephas microcarpa*, eastern slope of Peruvian Andes to three thousand feet; and *P–s macrocarpa*, up to four thousand; *P–s æquatorialis*, on the western slope up to five thousand. This last named palm is one of the grandest objects in the whole vegetable kingdom—its leaves thirty feet long, stem, or body only rises twenty feet; *palm ivory* is secured largely from these seed also.

Carludovica palmata—R. and P. on the east side of the Andes of Peru and Ecuador, up to four thousand feet. The fan-shaped leaves from cultivated specimens furnish the main material for the best Panama hats. *Jubea spectabilis* of Chili, 40° south latitude; *Trithrinax Brasiliana*, 31° south latitude; *Acrocomia Totai*, 28° south latitude; *Cocos yatai*, 32° south latitude; *C–s Australis*, 34° south latitude; *C–s Romanzoffiana*, 28° south latitude; *Diplothemium littorale*, 32° south latitude. All these last-named palms occur in Brazil; *Acrocomia* and *Trithrinax* extend to Paraguay, and *C. Australis* to Uruguay and La Plata State.

While some palms, as indicated, descend to cooler latitudes, others ascend to temperate and even cold mountain regions. Among American species prominent in this respect are: *Euterpe andicola*, *E. Hænkeana*, *E. longivaginata*, *Diplothemium Porallyi* and *ceroxylon pithyrophillum*—all occurring on the Bolivian Andes at an elevation of about eight thousand feet. *Ceroxylon andicola*, *Kunthia montana*, *Oreodoxa frigida*, and *Geonoma densa* reach also on the Andes of New Grenada an altitude of at least eight thousand feet; *Ceroxylon Klopstockia* to seven thousand five hundred, where Karstan saw stems two hundred feet high, with leaves twenty-four feet long.

There also are found *Syagrus Sancona* and *Platenia chiragua*, at five thousand feet, both very lofty palms. From the temperate mountain

regions of sub-tropical Mexico are known, among others: *Chamædora concolor*, *Copernicia pumos*, and *C–a nana* and *Brahea dulcis*, at elevations from seven thousand to eight thousand feet.

Zalacca secunda—Assam to north 28°. One of the stemless palms with large feathery leaves, exquisitely adapted for decorative purposes. (See Von Martius's great work for full descriptions of this princely order of plants.) Of those suited to our temperate clime those enumerated belonging to boreal extra-tropic Asia, from Silhet, 24° north latitude: *Calamus erectus*, *C–s extensus*, and *C–s quinquenervis*, from Garo at 26° north latitude; *Wallichia caryotoides*, *Ptychosperma gracilis*, *Caryota urens*, *Calamus leptospadix*, from Khrsya, in 26° north latitude; *Calamus acanthospathus*, *C–s macrospathus*, *Plectocomia khasyana*, from Assam, about 27° north latitude; *Areca Nagensi*, *A–a triandra*, *Livistona Jenkinsii*, *Dæmonorps nutantifloras*, *D–s Jenkinsii*, *D–s guruba*, *Plectocomia assamica*, *Calamus tenuis*, *C–s flagellum*, *C–s heliotropium*, *C–s floribundus*, *Phœnix ouseloyana*, from Upper Assam, between 28° and 29° north; *L. Caryota obtusa*, *Talacca secunda*, *Calamus mishmelensis*, from Darjiling, at 27° north latitude; *Wallichia obtusifolia*, *Licuala peltata*, *Plectocomia Himalayana*, *Calamus schizospathus*, from Nepaül, between 28° and 29° north latitude; *Chamærops Martiana*, from Guhrval, in 30° north latitude; *Calamus Royleanus*, from Saharampoor, in 30° north latitude; *Borassus flabelliformis*, from Duab, in 31° north latitude; *Phœnix sylvestris*, from Kherce, in 30° north latitude; *Phœnix numilis*, from Deccan; *Bentinckia coddapanna*, at four thousand feet altitude.

Encephalartos Denisonii, New South Wales and Queensland PINE–PALM. Very desirable; as also *E. spiralis*, *E. preissii*—great tenacity of life, even of large size; retains vitality for years. Thrives in California.

Aberia Caffra—KAI APPLE. Of Natal and Caffraria. A tall shrub for hedges. Rather large edible fruit, and as preserves. There are also allied South African species—*A. zeyheri* and *tristis*.

Acacia Arabica—GUM ARABIC TREES. Throughout Africa and Southern Asia. Small trees, to be utilized as thorny hedges; also, *A–a seyal*, and *A–a tortilis*, all furnish the best gum arabic. The lac insect lives on the foliage; thus we find the lac is mainly from this tree.

A–a falcata. Of Eastern Australia. One of the best anti-drift-sand trees; proven at the Cape of Good Hope. Several other species serve the same purpose, quickly restoring woods of sand dunes; *e. g.*, *A. pycnantha*, *A. saligna*, *A. cyanophylla*, and *A. salicina*.

A–a fasiculifera. South Queensland. Desirable for culture on account of the excellence of its easily worked wood.

A–a glaucescens. Queensland and New South Wales to sixty feet; a kind of Myall; hard, dark, pretty-grained, little scented wood.

A–a harpophylla. South Queensland. Yields a large share of "wattle bark" for tanning; wood brown, heavy, hard, and elastic; used by natives for spears.

A–a horrida—DOORNBOOM; KARRA DOORN, of South Africa. A formidable hedge bush, with thorns three inches long; exudes a good kind of gum; so, also, *A–a Giraffæ*.

A–a lophantha. Southwest Australia; common in California culture. One of the most rapidly growing trees for copses and first temporary shelter in exposed localities; seldom attains to the size of a real entitled tree; seeds abundantly; germinates most readily; suited to desolate desert tracts; of great importance to create a quick shade, shelter, and copious vegetation; cattle browse on it; bark contains only about eight per cent of mimosa

tannin; the dry root about ten per cent of saponin, valuable in silk and wool factories.

A–a pendula. New South Wales and Queensland. Generally in marshy tracts of the interior; one of the Myall trees.

A–a pycnantha—Of Victoria and South Australia. GOLDEN WATTLE. Deserves extensive cultivation, mainly for bark so rich in tannin. Of rapid growth, succeeds in sandy soil, seeds copiously, and they germinate with the greatest ease; never a large tree. Hon. F. von Mueller has proven the perfectly dry bark to yield twenty-five per cent of mimosa tannin, although in commercial condition contains ten per cent of this in moisture. The aqeous inf. of the bark can be reduced by boiling to a dry extract which in medicine, and other respects, is equal to the best Indian catechu (derived from *A. catechu* and *A. sundra*). This catechu is of great use for preserving from decay articles subject to exposure in water, such as nets, fishing lines, etc. The demand is daily increasing, and has already doubled in the last twenty years. Probably no other tan plants give so quick returns as this, particularly *A. decurrens* or BLACK WATTLE. Any bare, barren, and unutilized place could be sown to profit with a fair warrant of return in a few years. One half pound of wattle gives one pound of leather, whereas it requires five of oak; however, the tannin principle of both is not absolutely identical. With bichromate of potash gives a ruby-red dye; oxides of iron, red-brown; salts of iron, black.

A–a saligna. Of southwest Australia, where it is the principal tree chosen for tanner's bark, containing thirty per cent mimosa-tannin. Small, but widely-spreading tree, fit for avenues. Out of centuries of Acacias many might prove of great use.

Albizzia lebbek.—The SIRIS ACACIA of South Asia. Available in the warmer parts of California as a shade tree; also yields a good deal of gum.

Aloexylon agallochum. Cochin China, on the highest mountains. Would prove hardy here. The precious far-famed aloe wood, renowned for its balsamic fragrance and medicinal properties is derived from this tree.

Backhousia citriodora.—F. von Mueller. South Queensland. Only a small tree, yet worthy of culture for the fragrance of its lemon-scented foliage.

Balsamodendron Ehrenbergi—Deserts of Arabia. This tree yields the resin, myrrh, and a sour native Amyride, the allied *Bursere* indicates would flourish in the more arid parts of California. Prof. Oliver unites this with the following:

B–n opobalsamum—Kunth (*B. Giliadanse*—Kunth). Arabia and Nubia. This species furnishes the Mecca or Balm of Gilead. *B. capense* is closely allied from *S. Africa*. The American Balm of Gilead is from *Icica carana*: Incense wood from *I–a guianensi* American Elemi *I–a icicariba;* Resin of Corenia from *I–a ambrosicaca*; *Icica altissima*, a kind of cedar wood of Guiana (varies white and red). It is light, easily worked, and very aromatic (canoes forty-two feet long by five and a half wide are made from a single tree).

B–n mukul—Of Scinde and Beloochistan. Yields the fragrant Bdellium resin.

Boswellia papyrifera—In Morocco. Nubia and Abyssinia forms forests about Bertat on the atlas. Exudes a kind of olibanum resin, one of the hardiest species. *B–a glabra* yields a coarse resin, boiled in oil for pitching the bottoms of ships.

Berberis siatica—Himalaya. One of the best among numerous species with edible berries; also, *B–s lycium* and *B–s aristata*, which yields, besides a valuable yellow dye wood; the same remarks apply to our native *B–s*

pinnata. *B–s aquifolium* and *B–s fascicularis*, etc. Black or blue bloomed berries; flowers, yellow. Besides other barberries.

B–s Darwinii—Chili and South Chili. Considered one of the most handsome of all evergreen shrubs for garden hedges. Out of fifty species or more, others of great merit could be mentioned.

Butea frondosa—DHAK or PULAS of India. This magnificent leguminous tree extends to the Himalayan Mountains, hence suited to our clime. It is very rich in a peculiar kind of *kino*. The lac-insect is also nourished by this tree.

Buddlea madagascariensis—Madagascar. Of all these the most desirable for shelter copses, on account of its great size, always tidy appearance, and both for vigor and celerity of growth; besides, it is ever-flowering; flowers, as in figworts, like foxgloves.

Buxus sempervirens—Turkey Box Tree. South Europe, North Africa, Southwest Asia. Slow growing tree, and should be timely planted, to provide the indispensable boxwood for the engraver and musical instrument maker, for hitherto no good substitute has been discovered; needs calcareous soil for the best development. There are sixteen to twenty other species of Box, besides several close allies, yet so little is known of them we think it prudent to reserve an opinion. Some are large trees, and may be of more rapid growth.

Cæsalpinia coriaria—DIVIDVI OR LIBIDIBI TREE. Wet seashores of Central America. Could be naturalized in some of our salt marshes. The full grown tree produces annually one hundred pounds of pods, the husk of which is the most astringent of any known substance, and most quick acting tanning material in India. Commercially known as Divi-Divi; price of these pods, forty to sixty-five dollars per ton, or even more.

C–a sappan—Southern Asia. Wood yields a red dye. This shrub could be utilized for hedges; would prove hardy in places free from frosts.

C–a tinctoria—Of Chili. The bark yields a red dye.

Calyptranthes aromatica—BRAZILIAN SPICE–BUSH. Buds a good substitute for cloves and the berries for allspice, and belongs to the same myrtlebloom family. Another beautiful myrtad, in lat. 50° 30′ S. (Lord Auckland's islands), is the following: *Metrosideros lucida*. These, with their allied genera, *Psidium Cattleyanum* (like our own), bear fruit of excellent quality. The young bark and leaves used in medicated baths. Also, *Eugenia Cauliflora* is one of the most agreeable fruits of Brazil; as well as *E. Nharica*, berries of plum size; *E. pyriformis* and *Super-axillaris*, South Brazil, fruits of pear size; *E. rotundifolia*, Ceylon, to eight thousand feet, so suited to cool or cold climes; also, *E. revoluta*, six thousand feet, like a plum.

Caragana arborescens—PEA TREE, of Siberia. The seeds are of culinary value, but particularly used for feeding fowls. Leaves yield a blue dye.

Cassia fistula. South Asia. The very long pods of this ornamental tree contain an aperient pulp of pleasant taste. Traced by Dr. Hooker to the dry slopes of the central Himalayas.

Casuarina Decaisneana—BEEFWOOD. Of arid Central Australia. The largest and most valuable for our own desert regions; flourishes finely in California. No manifest leaves. Twig resembles scouring-rushes, or, like our Ephedral tea twigs of desert borders. Yields excellent timber, hard, heavy, and resembles the color of raw beef. New Holland war-clubs said to be made of it.

C–a torulosa. New South Wales and Queensland. The wood of this handsome tree is in demand for durable shingles and for furniture work; makes the best of oven fuel.

Catalpa bignonioides—CATALPA TREE, of South United States. Ornamental flowering tree, of ample foliage, and remarkable for rapidity of growth. As durable timber as the best chestnut. Does well here.

Chloroxylon swietenia—the SATIN-WOOD of the mountains of India. A kind of mountain mahogany; like the allied *Flindersia*, have dotted leaves, and so yield an essential aromatic "wood oil" of India; their astringent and fragrant barks cure intermittent and remittent fevers. Also several of these CEDRALADS, *e. g. Cedrela angustifolia*, with a strong odor of garlic; *C. toona*, Eastern Australia, yields a fragrant resin; *C. febrifuga* cures chills and fevers of Java; *Juriballi* bark of Demarara, of this order, a potent bitter and astringent far superior to Peruvian bark in low and malignant fevers, and powerfully diaphoretic taken warm, and is both cordial and cathartic. But *Chickrassia tabularis* bark contains some of these qualities without bitterness. The YELLOW WOOD of New South Wales, and Mahogany, have similar properties, and also belong here. The *Flindersia Bennettiane*, best of the *Yellow-Woods*, for avenue purposes.

Cistus creticus—LADANUM SHRUB, of Mediterranean region, and with *C-s cyprius* furnishes the best Ladanum resin; other species yield a less fragrant product.

Combretum butyraceum—BUTTER-TREE. Of Southeastern Africa; the Caffirs call it, the fatty substance of the fruit, "Chiquito," and is largely used by them as an admixture to their food and for a potation; is one fourth olein and three fourths margarin, aromatic. The *C-m alternifolium* exudes a gum like gum Arabic, soluble in water, but burning away in a candle flame. Many of these myrobalans are like myrtles and laurels; the fruit of the latter, native of California, yields a similar fat.

Terminalia alata. The bark astringent and anti-febrile. The fruit of *T-a chebula*, as also the galls, very much so; highly valued by dyers; with alum a durable yellow; ferruginous mud, an excellent black; some yield excellent timber; kernels of *T-a catappa*, and are eaten as almonds, and are very palatable; those of *T-a citrina* common Hindoo medicinal purge. The milky juice of *T. benzoin*, in dry concretion, the drastic gum is used in Mauritius as incense. These are chiefly adapted to the warmest portion of California.

Fitzroya patagonica—ALERCE. Of the Chilians; grows on swampy, moory places—near kin to the arbor vitæ—to fifteen feet in diameter; wood almost always red, easily split, light, does not warp; stands exposure to the air for half a century; in Valdavia and Chili almost all buildings are roofed with shingles of this tree; ought to be extensively planted in our unutilized swampy moors.

Psidium acidum—AMAZON GREAT GUAVA MYRTLEBLOOM. Mountain regions of the Amazon River; a tree thirty feet high; its guava fruit pale yellow, apple size; makes an excellent cooling conserve.

P-m chrysophyllum. F. v. Mueller. The guabinoba de mato of South Brazil; this tree also about thirty feet, but fruit the size of a cherry; other species of the *Abbevillea* section would be hardy here on the Pacific, and worthy of cultivation; also *P. pyriferum* and *P. pomiferum*, the latter most acid. In the mountains of Brazil *P. lineatifolium* is very promising; berry about an inch in diameter. Another of Uruguay, fruit of similar size, viz.: *P. malifolium.* Surely in the southern regions of this State where the native *psidiums* and *zizyphus* grow and fruit well, some of these would be found to flourish.

Pyrus salicifolia. Greece, Turkey, Persia, and Southwest Russia, fruit so mollifies as to be edible, yet it is mainly utilized as a superior stock for

grafting. So also might the JAPANESE EVERGREEN PEAR of such robust and vigorous growth in Alameda, California.

P–s nivalis or SNOW PEAR. Middle and South Europe. Eminently adapted for orchards of our higher mountain regions; fruit becomes soft and edible through exposure to snow; the wild state of this tree is probably *P. amygdaliformis.*

Rhus caustica—LITRE of Chili. A small sized tree; wood, very hard, superior for cogs, axletrees, and select furniture; neither caustic nor otherwise poisonous.

Royenia pseudo-ebenus—SOUTH AFRICAN EBONY. Only a small tree; wood, jet black, hard, and durable. Together with the following—*R–a pubescens*—suitable for all uses of the wood engraver; suggestive of the adaptability of many other woods in this large order of *Ebenaceæ*, or ebonies; as good substitutes for Turkey Boxwood.

Salix capensis—South African CAPE WILLOW. Close resemblance to the common *Weeping Willow*. The best for binding drifting sand, and for long, flexible twigs for withes, are *S. daphnoides*, of Europe and Asia; *S. petiolaris; S. cordata*, native of Pacific Coast, with *S. triste* and *S. longifolia*, etc.

S–x Humboldtiana—South American. Com'n; pyramidal in habit, to fifty feet or more. The wood is much used for yokes and other implements. A great number of species of willow can be grown for consolidating shifting sand ridges, besides the following beauty, to wit:

Chilopsis saligna. A tree to twenty or thirty feet; often only a bush; seldom over one foot in diameter. This TRUMPET-FLOWERED "*Desert Willow*" on streams and dry creeks of Southern California, through the arid interior, across the continent to Texas.

Santalum album—WHITE SANDAL WOOD. Of India; ascending to the temperate elevations of Mysore. A small or middle-sized tree, famed for its fragrant wood and roots. The greatest fragrance of the wood is generated in the drier and stony parts of mountains and hilly ranges.

S–m Freycenetianum produces sandal wood on the mountains of the Sandwich Islands up to three thousand feet. Several other species occur in Polynesia. The precious sandal oil is obtained by slow distillation from the heart wood and root, the yield being about two and one half per cent. In California, free from frosts, there can be no doubt of its feasible culture.

Saxe-Gothea—the MAHIN of Southern Chili. A middle-sized coniferous tree, already flourishing and seeding on this coast; has fine grained, yellowish wood.

Santolina Chamæcyparissus. Mediterranean region. A very aromatic and handsome bush, of medicinal repute; several allied species.

Sophora tetraptara—PELU of Chili and Patagonia. A small tree, with exceedingly hard and durable wood; much used for cogs, wheels, journals, and like mechanical structures.

S–a speciosa, or *Arizonica*, are large evergreen tree shrubs, very ornamental, especially those on the uplands of Texas. The terminal racemes of violet, lupin-like blooms, are very beautiful, and the wood may prove equally good.

Spondias (cytherea) dulcis—REWA. Fiji, Tongan, and Society Islands. A noble tree, to sixty feet high, laden with golden fruit of agreeable apple flavor (some compare both fragrance and flavor to the pineapple), and of "over eleven pounds weight." (?) These should be tested, as some species grow in Eastern Australia.

Swietenia Mahogani—The MAHOGANY tree. West India. The tolerance of this famous tree is not sufficiently known. In its native mountains it

ascends to three thousand feet, and if well sheltered this valuable timber probably could be grown on this coast.

Synoum glandulosum—Of New South Wales and south Queensland. This evergreen tree deserves cultivation in sheltered, warm, forest valleys, on account of its rose-scented wood. Some species of allied Dysoxylon have the odor of garlic—are even used in its stead.

Tamarix Gallica—FRENCH TAMARISK. Southern Europe, southern Asia, northern and tropical Africa. This shrub adapts itself in the most extraordinary manner to all sorts of localities—will grow alike in water and on the driest soils—and is one of the most grateful and tractable plants under culture; readily multiplied from cuttings which strike as easily as a willow, and push forth stems of unusual vigor; thrives well in California contiguous to the deserts of Mono Valley and elsewhere; hence one of the most eligible bushes, apart from its beauty, for planting on coast or interior to stay moving sands, or binding embankments. Our railroad interests can urge no objection whatever to its use.

T–x articulata—JOINTED TAMARISK. Northern and middle Africa and southern Asia. Of similar utility as *T. Gallica*. Also the same, or an allied species, extends to Japan.

T–x Germanica—GERMAN TAMARISK. Europe and western Asia. Likewise available for arresting the ingress of shifting sand, particularly in moist places; also for solidifying precipitous gulch and river banks, or to preserve wet weather runways and dry creeks from fearful gullying and loss of valuable lands. Its modest and relatively leafless mien are like a gauzy veil o'er the face of beauty—never aggressive nor overshadowing.

Tarchonanthus camphoratus. South Africa. This bush deserves attention medically. As an odorous rural plant is most acceptable.

Tectona grandis—TEAK. Of South Asia. This superb timber-tree has its northern limit in Bandalkland, at elevations of two thousand feet, which ought to encourage test-culture here.

Terminalia catappa—BELERIC MYROBALAN. India; ascending mountain regions. Few trees, as stated by Roxburg, surpass this in elegance and beauty. The seeds, kernels, or nuts, are eaten as almonds; palatable, of flavor of the filbert, and very wholesome. Its naturalization is especially desirable on account of the nuts. *T–a parviflora*, of Ceylon, forms a large tree, up to four thousand feet; the astringent fruits of several species form articles of trade, and much sought after for a lasting black dye.

Tristania conferta. New South Wales and Queensland. A noble, shady tree, of one hundred and fifty feet. Fine for extended avenues, etc., besides producing select and lasting timber; ribs of vessels from it have lasted unimpaired thirty years or more.

Triphasia aurantiola. Southeast Asia. A shrub worth cultivation for the exquisite fragrance of its flowers. The fruits, though small, are of pleasant sweetness. Might also be used for hedges.

Villebrunia integrifolia. India; Himalayan Mountains, to five thousand feet. A small tree, allied to the Ramie plant (*Bœhmeria nivea*). The fiber regarded as one of the strongest in India, being used for bow-strings. Other species, *e. g.*, *V. frutescens* also. Some *Debregeasia*—particularly *D. velutina*—deserve regular culture for the sake of their fiber. Particularly adapted, like the following section, to very moist ranges, of one hundred to two hundred inches.

To dwell on details of situation, soil, or clime, with reference to each particular tree, or a thousand and one other conditions, known or presump-

tive, would extend this catalogue to a very large volume, indeed; hence, to note at all must imply this feasibility for the few named. Suffice to say, in general terms, that the following New Zealand list of the Hon. James Hector's Hand Book* are better suited to Northern California, alpine or coast, and to Oregon, northward, where the Pacific climate is similar to that of New Zealand or Old and New England, *i. e.*, differing essentially from the general arid clime of Australia, and of Middle and Southern California, or approximate Arizona and Mexico.

ORDER CONIFIRÆ.

Dammara australis—KAURI PINE. The finest forest tree of New Zealand; one hundred and twenty to one hundred and sixty feet; eighty to one hundred feet of free shaft; ten to twenty in diameter. In high repute for masts and spars; durable for half a century, and even excavated after indefinite ages. The mottled kauri richly shaded, and diagonally cut to markings for furniture, etc. Occurs now only in North Island, and north of Mercury Bay, near the sea, on wet clay soils, mixed with other trees. The turpentine forms the celebrated "kauri gum," extensively exhumed from the sites of old extinct forests. (Of five thousand tons annually exported, the commercial value is about $3,000,000.)

Libocedrus doniana—KAWAKA, or as MOCK CYPRESS and CEDAR. A handsome tree of sixty to one hundred feet, by three to five; wood reddish, fine-grained, and heavy; used by the Maories for carvings; makes excellent planks and spars. Abounds in the forests of North Island and the Bay of Islands, to north of Auckland.

L–s Bidwellii—PHANTEA, CEDAR. A handsome conical tree, of sixty to eighty feet high. In Otago it produces a dark-red, free-working but rather brittle timber, mostly for inside work. On central ranges of North Island and common throughout the forests of South Island, at altitudes of five hundred to four thousand feet. For railroad sleepers and for fencing; formerly deemed only fit for inside work.

Podocarpus ferruginea—MIRO, BASTARD. BLACK-PINE, of Otago. A large ornamental and useful timber tree, of forty to sixty feet by two to three. Not so useful as the true BLACK PINE, or "MATAI." Reddish wood, close grained, and brittle; durable when only partially exposed to sea water. In north and south islands, below one thousand feet.

P–s spicata—MATAI, MAI. BLACK-PINE, of Otago. A large tree, of eighty feet by two to four. Wood yellowish, close grained, and durable. Of various uses, as piles for bridges, wharves, and jetties, bed-plates of machinery, millwright-work, flooring, house blocks, railway sleepers, fencing, etc. Logs exposed for at least two or three hundred years in overgrown dense damp wilds of North and South Islands. At altitudes under fifteen hundred feet.

P–s totara—TOTARA. A lofty spreading tree, sixty to one hundred feet by four to ten feet diameter. Wood very durable, and clean grained, in appearance like cedar, and works with equal freedom. Adapted to all kinds of carpenter's work; largely used in Wellington for house building, piles of bridges, and for wharves, and for railroad sleepers. One of the most valuable timbers known. The wood, if felled during the growing season, *resists the teredo* for a long time; splits freely, making durable fences and shingles, and as post-and-rail fences expected to last forty to fifty

*New Zealand Hand Book, by Hon. James Hector, M.D., C.M.G., F.K.S., Director of Geological Survey.

years. The Maories make their largest canoes of this tree, also palisades. Throughout North and South Islands, on both flat and hilly ground, the latter most durable.

P—s dacrydioides.—"KAHIKATEA." *New Zealand* WHITE PINE. A fine tree, one hundred to one hundred and fifty feet by four. Timber white, tough, and soft; for indoor work only, unless grown in dry soils; abounds in North and South Islands.

Dacrydium cupressinum.—"RIMU." New Zealand RED PINE. Pyramidal, with weeping branches when young; eighty to one hundred and thirty feet by two to six feet; both ornamental and useful timber; red, clear-grained, solid and heavy; much used for joists, planks, and for general building, and some furniture. Wellington southward. Handsomely marked, like rosewood, but lighter brown hue; decays by wet; juice like spruce for making beer. North and South Islands, but best inland.

D—m colensoi.—"MANOAS." *New Zealand* YELLOW PINE. A very ornamental tree, twenty to eighty feet; wood light yellow, the most durable and strongest timber of New Zealand. Posts of this wood have been in use among the Maories several hundred years. North and South Islands; up to four thousand feet altitude. A curious tree from having two kinds of leaves on the same branches; greatly valued for furniture.

Phyllocladus trichomanoides—"*Tanekaha,*" CELERY-LEAVED PINE. A slender, handsome tree sixty feet high, rarely exceeds three in diameter; wood pale, close grained, excellent as planks and spars, remarkable for resisting decay under moisture; grows in the hilly districts of North Island.

P—s alpinus—"TOATOA." A small ornamental and densely branched tree of two feet diameter; bark for dyeing, and making tar; North and South Islands.

ORDER CUPULIFERÆ.

(Of the BEECH, or *Fagus.*)

Fagus menziesii—MENZIE'S NEW ZEALAND BEECH, or RED BIRCH. (From the color of the bark); native "TAWHAI." A handsome tree, eighty to one hundred feet by two to three; timber durable; adapted to masts and oars, cabinet and cooper's work. Lake district of South Island at all altitudes up to three thousand feet, and in North Island on mountain tops.

F—s fusca—"TAWHAI," "TAWHAIRANUI"—"BLACK BIRCH" of Auckland and Otago (from color of the bark). A noble tree, sixty to ninety feet by five to eight; timber excessively tough and hard, both strong and durable for all uses. Found from Kaitaia, in North Island, to Otago, in South Island, up to three thousand feet altitude.

F—s solandri—WHITE BIRCH (from color of the bark) of Nelson and Otago. A lofty and beautiful evergreen one hundred feet high by four to five; heart black and very durable; for bridge piles, fencing, and bark for tanning. Occurs in southern part of North Island, and abounds in South Island at three to five thousand feet altitude.

ORDER—MYRTACEÆ. MYRTLEWORTS.

Leptospermum ericoides—MANUKA. A slender tree ten to eighty feet; highly ornamental, especially young; furnishes timber twenty-eight to thirty feet by fourteen inches at the butt, thence tapering to ten inches; wood dark and hard; largely used for fuel, fencing, ax, and tool handles, sheaves

of blocks, and by natives for spears and paddles—old timber of darker markings for cabinet work, and its great durability commends it for many other purposes. Highly valued in Otago for jetty and wharf piles, as it resists marine worms better than any other timber of the district; also much used for house piles, etc; the lightest colored woods deemed best and toughest, designated "WHITE MANAKA;" good substitute for "hornbeam" in cogs of large spur wheels. Found on the poorest soils.

Metrosideros lucida—RATA, IRONWOOD. A very ornamental tree; attains to thirty and sixty feet, by two to ten feet in diameter; valuable cabinet-wood; dark-red, splits freely, is used as knees and other ship timbers, would form cogs, etc. Rare in North Island, abundant in South Island, especially mountain coast.

M–s robusta—RATA. A tall erect tree of fifty to sixty feet by four; descending roots apt to form a hollow base twelve feet in diameter; timber like the last, *M. lucida*; equally dense and durable, but of larger dimensions. Grows on hilly situations of North Island from Cape Colville southward.

M–s tomentosa—POHTUKAWA. A tree of numerous massive arms, thirty to sixty feet, two to four in diameter; timber specially adapted to ship-building, and of quality superior to preceding (*M. robusta*). Grows on rocky coasts of the provincial district of Auckland.

ORDER—MELIACEÆ. MELIADS.

Melia azederach—PRIDE OF ASIA. Persia. The umbrella variety, preferable for rural shades; twenty to forty feet high by two to three through. Wood, durable; summer-green foliage large, clean, compounded; lilac flowers fragrant in open panicles; drupe-fruited or berry-like, sweetish and oily; eaten by domestic animals. Thriving in all, even sandy soils, and best if humid; growth luxuriant and rapid; the best of shades; suited to the interior of California, but does not do well on the coast.

Dysoxylon spectabile—"KOHE KOHE." A large forest tree, forty to fifty feet high; the bitter leaves used as a stomachic infusion; wood tough, but splits freely; durable as piles under sea water. North Island.

Eugenia maire—"MAIRETAWHAKE." A small tree of forty feet by one to two feet; timber compact, heavy, and durable; used for mooring posts, jetty piles, and also valuable as fencing. Swampy land of North Island.

ORDER—ONAGRACEÆ. ONAGRADS.

Fuchsia excorticata—KOTU KUTU. The fruit is called *Konini*. A small and ornamental tree, ten to thirty feet; sometimes three feet in diameter; timber durable; house-blocks of this wood are still sound after twenty years; could be used as a dye stuff, rasped and bled in the usual way, and by mixing iron as a mordant; shades of purple to black as a writing ink; juice astringent and agreeable; yields a medical extract; fruit pleasant, and is the principal food of the wood-pigeon. Throughout the islands.

ORDER—ARALIACEÆ. IVYWORTS.

PANAX *crassifolium*—"HOROEKA." IVY TREE. Ornamental, slender, and sparingly branched tree, singularly graceful in the young state, with long reflexed leaves; wood close-grained and tough; common throughout the islands.

Fatsia (Panax) *horrida*. A prickly shrub of six to eight feet, in Califor-

nia cañons as far south as Tamalpais Mountain, and northwardly to the Arctic; foliage one to two feet across. The following allied plant also should be tested.

Gunnera scabra—PANKE. Sandstone cliffs of Chiloe. Leaves eight feet across, and four or five of these Darwin found on a single specimen, like rhuebarb on a gigantic scale; these enormous leaves "presenting together a noble appearance!" Astringent; roots used by tanners, and fleshy leaf stalks eaten.

ORDER—ERICACEÆ. HEATHS, OR HEATHWORTS.

Dracophyllum longifolium—NEINEI. An ornamental shrub tree, with long grassy leaves; wood white, marked with satin-like specks; fine for cabinet work; in Sandwich Islands, and in Lord Auckland's group; Campbell Island; in the vicinity of Dunedin to ten to twelve inches in diameter.

ORDER—VERBENACEÆ. VERBENAS.

Vitex littoralis—PURIRI. A large tree, fifty to sixty feet; trunk six to seven feet diameter; wood hard, dark olive brown; much used; reputed indestructible under all conditions; northern parts of North Island only; supremely valuable for railroad sleepers; perhaps only equaled by its kin TEAK, *Tectona grandis*; of the forest mountains of Malabar, Pegu, and other East Indian districts; an enormous deciduous tree; timber abounds in particles of silex, and has no rival in Asia for durability; the wood has much the appearance of coarse mahogany, and though lighter, is very strong, and for ship building perhaps the best in the world; flowers diuretic, and foliage yields a red dye.

ORDER—LAURINEÆ. LAURELS.

Nesodaphne tarairi—"TARAIRI." Forest tree, sixty to eighty feet, with stout branches; wood white; splits freely, but little used. Northern parts of North Island.

N—e tawa—"TAWA." A forest tree, sixty to seventy feet, with slender branches; wood light and soft; much used for butter-kegs. Northern parts of South Island and in North Island, in large forests of river flats.

ORDER—CORNEÆ. CORNELS.

Griselinia littoralis—PUKATEA, BROAD-LEAF. An erect, thickly-branched bush-tree, fifty to sixty feet high, three to ten feet in diameter; wood splits freely; valuable for ship-building and for fencing; and portions of it make fine veneers. Found chiefly in the South Island, near the coasts.

ORDER—COMPOSITEÆ. COMPOSITES.

Olearia avicenniæfolia. MINGIMINGÉ. YELLOW-WOOD. An ornamental shrub-tree; flowers numerous; trunk two feet in diameter; wood close-grained, with yellow markings, which renders it desirable for cabinet-work. Mountains of North Island and throughout South Island.

O—a cunninghamii. Ornamental shrub tree of twelve to twenty feet high; flowers very showy; abundant on the west coast of South Island, and in North Island.

ORDER—MONIMIACEÆ. MONIMIADS.

Atherosperma novæ-zealandica—"PUKATEA." Tree one hundred and fifty feet, buttressed fifteen feet of the base; trunk three to seven diameter; wood soft and yellowish; fine for small boat planks. A variety has dark wood that is very lasting in water; prized by Maories for canoes. North Island and the northern parts of South Island.

Hedycarya dentata—"KAIWHIRIA." A small evergreen tree, twenty to thirty feet high; wood finely marked, and suitable for veneering. North Island, and so far south as Akaroa, in South Island.

ORDER—PROTEACEÆ. PROTEADS.

Knightia excelsa—"REWAREWA." A lofty, slender tree, one hundred feet high; wood handsome, of mottled red and brown; most valuable for veneering, and for shingles and fencing, as it splits easily. In the forests of North Island, upon hills of both rich and poor soils.

ORDER—MAGNOLIACEÆ. MAGNOLIAS.

Drimys axillaris—"HOROPITO," PEPPER TREE. *Winter's Bark.* A small, slender evergreen; very handsome; whole plant aromatic and stimulant; much used by the Maories for various diseases; wood very ornamental in cabinet work; makes beautiful veneers; grows abundantly in forests throughout the islands, at altitudes of one thousand feet; foliage becomes dense and reddish.

D–s colorata. Very distinct species; quite common near Dunedin. A very ornamental shrub tree; leaves blotched with red.

ORDER—VIOLARIEÆ. VIOLETWORTS.

Melicytus ramiflorus—"MAHOE." "HINAHINA." A small tree, twenty to thirty feet high by two feet or so diameter; wood soft; not in use. Abundant throughout the islands so far as Otago. Leaves greedily eaten by cattle.

ORDER—MALVACEÆ. MALLOWWORTS.

Moheria populnea—"HOUHERE." RIBBONWOOD, of Dunedin. An ornamental shrub-tree, ten to thirty feet high; bark fibrous, and used for cordage and cloth of Maories. Affords a demulcent drink. The wood splits freely for shingles, etc., but is not durable. Abundant throughout the islands.

ORDER—ANACARDIACEÆ. ANACARDS, OR TEREBINTHS.

Pennantia corymbosa—"KAIKOMAKO." A small but very graceful tree, with white sweet-scented flowers; twenty to thirty feet high; wood used by the Maories for kindling fires by friction. On the mountains of North Island, and abounds on the South Island.

ORDER—RHAMNEÆ. RHAMNADS.

Discaria toumatou—"TUMATAKURUS." WILD IRISHMAN. Bush or small tree of spreading branches; properly trained would form a handsome hedge stronger than the white thorn; spines used by natives for tattooing.

ORDER—SAPINDACEÆ. SOAPWORTS.

Dodonæa viscosa—"Ake." Wood very hard, variegated black and white; used for Maori-clubs; abundant in dry woods and forests.

Alectryon excelsum—"Titoki." A beautiful tree, with large panicles of reddish flowers; trunk fifteen to twenty feet high, foot or more in diameter; wood like ash, and used for similar purposes; its toughness renders it valuable for wheels and for coach building generally; the oil used for anointing. In North and South Islands, abounds in forests.

ORDER—LAGUMINOSEÆ. LEGUMINOUS PLANTS.

Sophora tetraptera—"Kowhai." A small or middle sized tree of splendid appearance, with large pendulous yellow flowers; wood red, highly durable, and valuable for fencing and cabinet work, for bridges, piles, and wharves, etc. Abounds throughout the islands.

ORDER—SAXIFRAGEÆ. SAXIFRAGES.

Carpodetus serratus—"White Mapau." White Birch. (Of Auckland.) A small tree of ten to thirty feet; slender branches, spreading, fan-form, very ornamental, with a profusion of white flowers; wood soft and tough, good for ax and other handles. North and South Islands, by river banks.

Weinmannia racemosa—"Towhaï." Kamaki. A large tree, fifty feet high, two to four feet in diameter. Wood close-grained and heavy but rather brittle; good for joiner's tools and carving blocks, for paper and calico-printing, turnery and wood-engraving, etc. Bark largely used for tanning. Yields an extract like gum Kino. Middle and southern part of North Island and throughout South Island.

ORDER—RUBIACEÆ. STELLATES OR MADDERWORTS.

Coprosma Clinearifolia—Karamu. An ornamental shrub-tree; wood close-grained and yellow; might be used in turnery; grows in the mountains of North and South Islands. Other species grow to considerable size, and have highly ornamental timber. *C–a baueriana* commended as a substitute for coffee.

ORDER—JASMINEÆ. JASMINWORTS.

Olea Cunninghamii—Black Maire. Tree forty to fifty feet high, three to four feet diameter. Timber close-grained, heavy, and very durable—abounds.

ORDER—SANTALACEÆ. SANDALWORTS.

Santalum Cunninghamii—"Maire." A small tree ten to fifteen feet high, six to eight inches diameter; wood hard, close-grained, and heavy. Used for war implements of Maoris; substitute for box by wood-engravers.

Erythroxylon coca—Coca, Spadle. A highland Peruvian shrub, famed for the marvelous energizing properties of the leaves; their almost fabulous power over privation and fatigue, which enables the coca chewer to endure unwonted and persistent labor, greatly commend it to trial culture. They contain two alkaloids, cocain and hygrin, also a peculiar tannic acid.

Phœnix dactylifera—Date Palm. North Africa and inland Arabia and

Persia. This noble palm attains to eighty feet; is unsexual; of great longevity. The sap yields sugar or palm wine, the leaves for hats, mats, etc.; a fine scenic landscape ornament; famous food, fruits in succession throughout the season in bunches of two hundred or so; a great boon of the oasis of desert tracts, mountain valleys, and even-tempered lowlands; the unexpanded flower-bunches can be used as palm-cabbage, and the fiber of the leaf stalk for cordage. In the south of Europe date forests prove of immense value, and the ease with which this palm grows from seed affords great facility of culture in southern and southeastern climes of California. The varieties of Gomera are large, and contain no seed; varieties vary in shape, size, and color of fruit.

Plectocomia Himalayana—RATTAN PALM. Sikkim, up to seven thousand feet. Requires moist forest land. Of such diverse utility is worthy of culture, but the canes are not durable; hardiest among its congeners.

Calamus montamus—The CLIMBING CANE PALM. *Himalaya* up to six thousand feet; hardy climbing palm. Aged canes naked. Of these the light, strong suspension bridges over the large rivers of Sikkim are made; supplies the strongest ropes for hauling logs from the forests. The most durable baskets and cane-work of chairs are made from the slits; also, walking-sticks, riding-canes, etc., are cut from this and other species of calami, but few, if any, are equally hardy.

Bactris gisipæs—H. (guilielma speciosa, Mort.)—PEACH PALM. Of the Amazon River; stems clustered to ninety feet; mealy pericarp cooked; superior to chestnut; an object of great grandeur.

Raphis flabelliformis. China and Japan; very slender palm, only a few feet high, for table decoration.

Bambusa arundinacea—THORNY BAMBOO. India; requires rich moist soil, and delights on river banks; not so high as *B. vulgaris*; sends up numerous stems from the root; the branches bending, thorny at the joints; seeds useful food for fowls.

B–a attenuata—HARDY BAMBOO OF CEYLON. On mountains four thousand to six thousand feet; to a height of twenty-five feet.

B–a elegantissima. Mountains of Java; four thousand feet; very tall, and exceedingly slender; upper branches pendulous; a hardy species.

B–a monadelpha. Ceylon; on mountains four thousand to six thousand feet high; a dwarf but handsome bamboo of only twelve feet.

B–a spinosa. Bengal tall species; cavity small and hence strong.

B–a stricta. India, particularly Bengal; on drier ground than *B. arundinacea;* smaller, and quite straight, more strong and solid.

B–a vulgaris—COMMON BENGAL BAMBOO. Large and unarmed; attains to seventy feet; may even reach forty feet in a single season; resists occasional frosts; best for building houses; in water for some time renders the cane still firmer. To the large and thornless bamboos belong *B. tulda*, *B. balcooa*, of India.

B–a Thouarsii. From Madagascar and Bourbon. These and many others much used for various furniture, mats, implements, etc.

Guadua augustifolia. New Granada, Ecuador, and other Central American states. Forty feet. May prove hardy in sheltered places of some lowlands.

G–a latifolia. One of the tall bamboos of Central America. This guadua is stouter than any Indian bamboo. In tropical America native bamboos are planted for hedges.

Psidium Araca—GREENISH-YELLOW GUAVA. West India and Guiana to Peru and Brazil, where it is in dry high-lying places. Greenish yellow berry of exquisite taste.

P–m arboreum—The Guava. Brazil; Province of Rio Janeiro. Fruit about one inch, and excellent flavor.

P–m Cattleyanum—Purple Guava. Brazil and Uraguay. One of the hardiest of guava bushes; attains to twenty feet. Purple berries, seldom over one inch long, but delicious flavor; taste like strawberries. *P. buxifolium*, of Florida, seems nearly related to this species. *P. cinereum*, Brazilian Province of Minas Geraes, yields an edible fruit. *P. cuneatum*, also; greenish; size of plum.

P–m cordatum—Spice Guava. West India. A tree; fruit edible.

P–m grandifolum. Brazil. Rather dwarf shrub. Berries size of a walnut; edible.

P–m Guayava.—The Large Yellow Guava. Of India, Mexico, to South Brazil. This handsome and very useful evergreen bush should become a universal favorite in all our warm low lands for the sake of its aromatic, wholesome berries—the size of a hen's egg—which can be converted into a delicious jelly. The pulp, generally cream-colored or reddish, varies with varieties under culture, and some bearing all the year round. Propagation is easy from suckers, cuttings, or seeds.

P–m polycarpon. From Guiana to Brazil; also in Trinidad. A comparatively small shrub, bearing prolifically and almost continuously its yellow berries, size of a large cherry, and of exquisite taste.

P–m rofum. Brazil, in province of Minas Geraes, on subalpine heights; to ten feet, and is likely the hardiest of all the species producing palatable fruit.

Adenostemum nitidum.—South Chili. Queale, Nable, and Aracoco. A stately tree; wood durable and beautifully veined; fruit edible.

Juglans Sieboldiana. Throughout Japan, where it forms a large tree; *J. cordiformis* closely approximates it. The *J. Mandschurica* of that place and Corea is a walnut allied to our *J. cinerea* or butternut. None of these trees, however, will attain proper size or prosperous growth if the tap-root is cut off or leadertop.

Sweet-fern Tree. (New.)—*Lyonsthamnus, asplenifolius*. Greene, California.

Lycium Afrum.—Africa and southwest Asia. Our native *L. Andersonii*, and several others, also bear beautiful amber edible berries, and might be utilized as hedge bushes, and as stocks for choicer sorts.

The bamboos already introduced flourish so well in California more should be tested. Being of such manifold use, grandest among grasses, elegant and graceful, and as many of them delight in the cooler mountain air, of the easiest possible culture, and the most rapid growth, out of about two hundred, or say possibly three hundred sorts, we quote a few following, furthermore from Baron F. von Mueller's list, to wit:

Arundinaria Japonica. To twelve feet.

A–a macrosperma. North America, thirty-five feet.

A–a verticillata. Brazil, to fifteen feet.

A–a debilis. Ceylon, up to eight thousand feet; a tall species.

A–a acuminata. Mexico, twenty feet high.

A–a falcata. Himalaya; ascends to ten thousand feet; twenty feet high.

A–a tesselata. South Africa; ascends to six thousand five hundred feet; twenty feet high.

A–a callosa. Himalaya, to six thousand feet; twelve feet high.

A–a Khosiana. Himalaya, also six thousand feet; twelve feet high.

A–a Hookeriana. Sikkim, up to seven thousand; fifteen feet high.

A–a suberecta. Himalaya, four thousand five hundred; fifteen feet high.

Thamnocalamus Falconeri. Himalaya, to eight thousand feet; tall.

T–s spathiflorus. Himalaya, to ten thousand feet; tall.
Phyllostachys bambusoides. Himalaya, China, and Japan; twelve feet.
P–s nigra. China and Japan, twenty-five feet.
Arthrostylidium longiflorum. Venezuela, to six thousand feet.
A–m excelsum. West Indies, eighty feet high by one foot diameter.
A–m racemiflorum. Mexico, to seven thousand five hundred; thirty feet high.
Aulonema Quixo. New Grenada and Venezuela; cool regions; tall and climbing.
Macrostachys ternata. Southern Brazil; height twenty feet.
Also, *M–s Clausseni*, of Southern Brazil, eighty feet, and *M–s Kunthii*, of Southern Brazil, thirty feet.
Chusquea simpliciflora. Panama, eighty feet; scandent.
C–a abietifolia. West Indies; tall scandent.
C–a culcou—Chile, twenty feet; straight.
C–a uniflora. Central America, twenty feet.
Chusqua Galleottiana. Mexico; to eight thousand feet.
C–a montana. Chile Andes, ten feet.
C–a Dombeyana. Peru, to six thousand feet; ten feet.
C–a Fendleri. Central America, to twelve thousand feet.
C–a Scandens. Colder Central America; climbing; tall.
C–a Quila. Chile; tall; also, *C–a tenuiflora*; twelve feet high.
C–a Guadichaudiana and *C-a capituliflora.* Both very tall. South Brazil.
Platonia nobilis. New Granada, colder region.
Nastus Borbonicus. Bourbon, Sumatra; to four thousand feet; fifty feet high.
Guadua Tagoara. South Brazil; to two thousand feet; thirty feet high.
G–a macrostachya. Guiana to Brazil; thirty feet high.
G–a capitata. South Brazil; twenty feet; and *G–a virgata*, twenty feet.
G–a refracta. Brazil; thirty feet; and *G–a paniculata*, thirty feet.
Bambusa nutans. Ascends Himalaya to seven thousand feet.
B–a tuldoides. China, Hong Kong, Formosa.
B–a pallida. Bengal to Khasia; to three thousand five hundred feet; fifty feet high.
B–a polymorpha. Burmah, in the Teak region; eighty feet high.
B–a Balcooa. Bengal to Assam; seventy feet high.
B–a flexuosa. China; to twelve feet.
B–a Blumeana. Java; tall.
B–a arundinacea. South India; fifty feet.
B–a Spinosa. Bengal to Burmah; one hundred feet high.
B–a vulgaris. Ceylon and elsewhere in India; to fifty feet high.
B–a Beecheyana. China; twenty feet high.
B–a marginata. Tenasserim; ascends to five thousand; tall; scandent.
B–a regia. Tenasserim; forty feet high.
B–a Brandisii. Tenasserim; up to four thousand; one hundred and twenty feet high by two feet girth.
Gigantochloa maxima, Kurz; (*Bambusa verticillata*, Wild). Java; grows to one hundred feet.
G–a attar. Java; to forty feet.
G–a heterostachya. Malacca; to thirty feet.
Oxytenanthera Abyssinica. Abyssinia to Angola; to four thousand feet; height fifty feet.
Oxytenanthera nigro-ciliata. Continental and Insular India; to forty feet.
O–a albo-ciliata. Pegu, Moulmein; tall; scandent.

O–a Thwaitesii. Ceylon; to five thousand; height, twelve feet.
Melocanna bambusoides. Chittagong, Sylhet; to seventy feet.
Schizostachyum Blumei. Java; very tall.
Cephalostachyum capitatum. Himalaya; to six thousand; thirty feet high.
C–m pallidum. Himalaya; up to five thousand; tall.
C–m pergracile. Burmah; to forty feet.
Pseudostachyum polymorphum Himalaya; to six thousand feet; very tall.
Teinostachyum attenuatum, Munro; (*Bambusa attenuata,* Thw.) Ceylon; ascends to six thousand feet; twenty-five feet high.
T–m Griffithi. Burmah; tall; slender.
Beesha Travancoria. Madras; tall.
B–a Rheedei. South India; Cochin-China; twenty feet high.
B–a stridula. Ceylon.
Beesha capitata. Madagascar; fifty feet.
Dendrocalamus strictus. India to Japan; to one hundred feet.
D–s sericeus. Behar; to four thousand feet; tall.
D–s flagellifer. Malacca; very tall.
D–s giganteus. Burmah; Penang; exceedingly tall, by two feet.
D–s Hookeri. Himalaya; ascends to six thousand; fifty feet high.
D–s Hamiltoni. Himalaya; also six thousand feet; sixty feet high.
Dinochloa Tjankorreh. Java; Phillippine; ascends to four thousand feet; climbing.

Ægiceras majus. South Asia, Polynesia, North and East Australia, South to New South Wales, the *Mock–Mangrove.* For staying the off-flow of tide mud, and thus consolidating shores subject to sea floods.

Ailanthus glandulosa. Valuable for reclaiming coast lands. Wood extremely durable.

Avicennia officinalis. Dr. Behr's suggested tree for consolidating muddy tidal shores. South Asia and South Africa, Australia, and New Zealand.

Berberis buxifolia—Boxleaf Barberry. Chile, Straits of Magellan. Bush the best for berries of South American species, relatively large, black, but hardly acid; slightly astringent; edible.

Cajanus Indicus—Tree Pea. India and Africa. Attains to fifteen feet; yields four thousands pounds of peas to the acre; can be used as peas in the green or mature state; requires the richest soils of Egypt. Yields a fair crop the first year.

Zizyphus lotus—Lote–Bush. The tree bush which gave name to the ancient *Lotophagi*; the fruit is to this day collected as food by the Arabs of Barbary. As we have a native species, *Z. Parryi*, fruit of the size of a cherry or small plum for preserves, the foreign will no doubt flourish well.

Z–s jujuba. East Australia; subtropic latitudes, and likewise Africa. Attains height of forty feet.

Melicocca bijuga. Mountains of Central America, West Indies. Cultivated in Brazil for its agreeable sub-acid vinous berries, having the pulp of grapes and similar taste, and the seeds can be used as sweet chestnuts. A tree of sapindaceous or horse-chestnut alliance.

Moringa pterygosperma—Horse–Radish Tree. India; middle mountain region. The long pods edible. Seeds somewhat almond-like, rich in oil. *M. aptera* is in Abyssinia. Egypt, Arabia, and Syria.

Morus celtidifolia—Nettle–Leaf Mulberry. Peru to Mexico; up to seven thousand feet. Fruit edible. *M. insignis*, from New Granada, is a similar species.

Myoporum lætum—New Zealand. "Nagio." As a shelter tree, equal to *M. insulare* for the most exposed parts of the coast. Excellent for shade,

and wood takes a fine polish. Can be raised on the beach, from cuttings. Sheep and horses browse on the foliage.

Myrica cerifera—The WAX MYRTLE, of United States. *M. Cordifolia*, South Africa, and *M. quercifolia* and *M. serrata* are wax bushes suited to fixing the rolling sands of seacoasts. Myrica-wax is heavier than beeswax, harder, more brittle, and takes a smoother surface, but melts easier. Is obtained from the surface of the fruit, by boiling during the cool season. Sowing the seed after the first rains of the cool months has steadied the sand, or plants can be multiplied by cuttings. It also spreads by subterranean creeping stems, with age.

Myrtus edulis, Benth. (*Myrcianthes edulis*, Berg). Uruguay. Tree attaining the height of about twenty-five feet. Berries one and one half inches diameter, of pleasant taste.

Dendromecon flexilis. Greene (New).

REPORT OF THE ENGINEER

OF THE

STATE BOARD OF FORESTRY.

LETTER OF SUBMITTAL.

To the State Board of Forestry: the Hon. ABBOT KINNEY, *the Hon.* JAS. V. COLEMAN, A. KELLOGG, M.D.:

GENTLEMEN: During the month of May last, I was commissioned to visit such portions of the timbered districts of the State as the time remaining to the Board to prepare its first annual report would admit of. I was directed to prepare a forestry map of the districts visited, and to collect all obtainable information bearing upon the subject of forestry; not merely considering the same as the art of fostering and maintaining the growth of trees, but with reference more particularly to the influence which forests have upon climatic conditions, and the amount of water carried by streams. I was instructed to determine the extent and character of the wooded districts visited, to estimate their capacity for furnishing useful woods, to note the rate of decrease under present market demands and from other causes, as also to examine their reproductive capacity and the extent and rapidity of new growths; in short, to collect all data which might assist the Board in determining the probable conditions which the changes in course of progress are liable to produce.

The time of operation in the field was embraced in the period between the sixteenth day of June and the twenty-seventh day of September—three and one half months in all. During this time the timber belt of Sonoma County, the Counties of Mendocino, Humboldt, Del Norte, and Trinity, and a small portion of Shasta County were visited. The maps submitted with my report show the forest-growths of this district, and material was furnished for preparing a map of Lake County, by Mr. Saml. Rice, County Surveyor, whose unremunerated service to the Board is herewith gratefully acknowledged.

The wording of the report might be at times misleading, the term "Coast Range" often being used without reservation.

This was generally done for brevity's sake, although the general character of the forests, save that it grows lighter as the Bay of San Francisco is approached, does not materially differ from that of portions covered by the report, which are correspondingly located in point of general topography. Notwithstanding this fact, the statements can, of course, be only strictly applied to the portions of the Coast Range actually visited.

Occasion is herewith taken to acknowledge the assistance rendered and the courtesy so universally shown to your Engineer while on his trip. To mention by name all those to whom he feels indebted for aid in his labors, would be a task more easily commenced than terminated.

Appendix C contains a list of a few of those who have especially contributed to make the report of value, and if occasion is taken to make special mention of their names, it is with the selfish motive of adding to the report the weight and authority which their acknowledged familiarity with the country cannot fail to carry with it.

The comprehensiveness of the method of inquiry directed by the Board must plead my excuse, if I have often been led into topics apparently outside the strict province of forestry; but the relations of agriculture and water supply stand so directly connected with forestry that the latter could not be comprehensively treated without some consideration of the others.

Respectfully submitted.

HUBERT VISCHER.

SAN FRANCISCO, November 6, 1886.

I.

INTRODUCTION.

General Character of the Coast Range.

Topographical and Hydrographical Features.

Necessity of, and Facilities for, Irrigation.

Summary Enumeration of the Zones of Tree Growths.

INTRODUCTORY REMARKS.

The Coast Range to the north of the Bay of San Francisco is a peculiarly dislocated complex of mountains, to briefly enumerate the salient points of which, some license in description must be granted. Its most characteristic feature is the double vertebræ which follows the line of the coast; and the law which is observed by the mountain chains, the rivers conform to also, flowing for long distances parallel with the coast before finding an outlet to the ocean.

It would indeed be difficult to instance another district of similar extent, and especially of such limited width, with so many watercourses of considerable length.

The topographical disposition, and the erosible character of the range, explains the deep-seated watercourses which form the main drainage arteries of the belt, as also their low rate of grade.

What the main streams lack in fall, their tributaries derive the advantage of, the whole country being divided up into long drawn ridges of considerable height, but no breadth, and the rivers being depressed into deep gorges, the secondary streams cannot be other than short, and their descent precipitous.

The most abundant of rainfalls, unless evenly distributed throughout the seasons, would fail to produce uniform conditions of flow in a water system like this, and it is but natural that the rivers should be torrents in the rainy season, and mere threads of running water in Summer. The Klamath River, just below the mouth of the Trinity, has been known to rise, after continuous rains, ninety odd feet, and during the Summer it is but an inconsiderable stream, which at points might almost be forded.

Indeed, it is questionable to what extent the rivers of the range might not be depleted in Summer, were it not for the influence of their high-lying sources, which are always more or less eked out by residual snows which hang on the highest peaks until late in the season.

It needs but the barest statement that there is but little room for extensive valleys in a range so cut up and broken; by which, however, is not implied that small valleys are not to be found at the heads of the rivers, or that bottom lands do not exist near their mouths.

The general trend of the coast, while in the main it runs north and south, has also a decidedly westerly element, and the ridges deviate even more from truly north and south lines. The whole system of ridge-chains and spurs consequently lies angling to the cardinal points of the compass. The prevailing storms come from the southeast and southwest. It will therefore be readily seen that hardly a divide or a spur exists but what presents varied exposures to both sun and wind, and it is equally evident that the sunny exposures are also the storm-swept ones, while the lee sides are those favored by shade. With these two elements intimately connected is both the accumulation of soil and the retention of snows. All the conditions

conducive to the growth of trees stand ranged together on the one hand, all those opposed to it are equally combined on the other; shade, shelter, soil, snow, as against all the elements that tend to produce arid and barren conditions.

Throughout the range the tree growths respond to these two opposed combinations, and to such a degree that the influence of altitude falls completely into the background as compared with that of exposure. This law holds good everywhere. Even in the densest forests of the redwood belt, the southern exposure always shows less fine timber, and is less heavily clothed than the one facing it—barring only such cases where, owing to local topographical configuration, the naturally sheltered slope chances to be the wind-swept one. Through all the gradations of arboreal development the difference can be traced; to open land succeeds brush; upon brush follows timber, and, as between timber growths, stand opposed lighter and heavier growths. Always with the sheltered, northerly (or easterly) exposure goes the higher state of growth, while the sunny, southerly (or westerly) slope shows a lower order of vegetation. The effect is so striking that whole sections of country will appear either well timbered or almost bald, according to the point from which they are viewed.

Equally important with the influence upon timber growth is that exerted by "exposure" upon springs and running water, and, of course, vegetation and aqueous supply are interdependent quantities.*

The Coast Range, generally speaking, notwithstanding its heavy annual rainfall, forms no exception to the general rule in California; it has a period of drought, or, at least scarcity of moisture during a certain period of the year. This, for the Coast Range, lasts say from the end of July until the first rains fall, about the end of September.

While it has been stated that the acreage of valley and bottom land in the range is but limited, much upland will be found, the soil of which is suitable for agriculture. Even though at present lying fallow, even though its suitability for crops may now be doubted, the time will come when these lands, under the influence of increased population and growing scarcity of fertile land, will be required for cultivation. Subject to late frosts, and with a rainy season lasting until well into May or June, agricultural operations can only be started late in the season, and the period in which crops must grow and mature is limited to a few months.

Owing to steepness of slope the upland arable lands are generally little adapted to holding moisture, and crops which are barely well started are caught by the drought, and though otherwise promising, fail to produce anything but insignificant yields. There are thousands of acres in the counties treated of in this report which would be highly suited to produce either fruit, vegetable, or grain crops could they but be supplied with even the most meager aid through irrigation at the proper time.

The agricultural development of the uplands of the Coast Range—and there is but little else but uplands—will be as dependent upon irrigation in time as are the lands of the southern portion of the State now.

Referring to our notes upon the general hydrographic conditions of the range, it may be inquired how can water be procured? The location of the main streams being depressed, and their grade slight, to bring water upon uplands would imply outlays which the value of the lands will never warrant; storage of water in the tributary streams and gulches cannot suc-

*No more striking illustration could be furnished of how dependent the supply of running water is upon exposure and timber growth, than in following the right bank of the Klamath River, to note how every ravine carries water as far down as Orleans Bar, while shortly after passing the bend of the river, all the short watercourses fail during Summer.

ceed, owing to the precipitous slope of their channels and the consequent lack of storage depth. Storage of water upon higher lying lands may, in special cases, succeed, but generally will be unfeasible, as the arable lands which it is sought to water are themselves in most cases situated at considerable elevations (upon flat ridge summits or upon the upper brow of slopes—it is only here that suitable soil deposits exist). Wells and the development of springs will be found like the last expedient, only applicable in exceptional cases.

Of all the means of storing water only one remains—nature's own means. It is only necessary to prolong the flow of the natural channels for a short period—a month or a fortnight would often suffice—and to accomplish this is within the power of being effected by stimulating tree growths upon very limited areas of ground, especially if due regard be had for impounding snow where practicable.

Well wooded as the Coast Range may be—and just how well wooded it is, an effort shall be made in the report to show—the aid of forestry may prove a matter of fully as much importance to a thorough development of the natural resources of the Coast Range as in other apparently more needy districts.

Although the maps accompanying the report give specific information as to the timber growths all over the range, and reference to the character of the timber at various points will be made in the paragraphs treating of the different trees, it is here deemed fit by way of introduction to sketch out in the broadest lines the character of the timber growths encountered:

a. Immediately along the coast shore, and outside the redwoods, brush growths and a growth of conifers of various kinds and of lesser economic importance.

b. The redwood belt, occupying the western slope of the outer backbone of the Coast Range.

c. Following the redwoods, a separate development of trees which are found in the redwood belt in conjunction with the redwood; zone of Douglas spruce, tanbark oak, chestnut, etc.

d. Belt of open wooded lands generally adapted to grazing or agriculture; oaks, yellow pine, and spruce.

e. Zone of coniferous trees of the Sierra Nevada; sugar pine, yellow pine, incense cedar, firs, and Douglas spruce.

f. The slope to the Sacramento Valley; belt of small pines and oaks.

II.

THE REDWOOD.

Description of the Belt; its Extent and Character.

Estimate of the Redwood Resource and the Redwood Cut.

The Efficiency of Redwood Logging and Manufacture, as an Art.

The Reproductive Capacity of the Redwood.

THE REDWOOD.

Sequoia Sempervirens.

DESCRIPTION OF THE BELT; ITS EXTENT AND CHARACTER.

As shown by the maps which accompany this report, the redwood belt extends from southern Sonoma County to within a few miles of the Oregon line, and though the tree seldom comes down to within a mile of the ocean, nor often crosses the outer coast divide, for purposes of rough characterization, the ridge summit and the shore line may be considered its limits on the east and west.

The term "belt," when used in connection with the redwood, is perhaps more strictly applicable than as applied to forest areas in general; nevertheless, it should simply be understood as designating the area within which more or less heavy growths of redwood occur, without implying either an exclusive or an uninterrupted development of this stately tree.

Throughout the belt a more or less considerable percentage of other trees will always be found interspersed with the redwood, and often completely displacing the latter.

In fact, in the more southern portions of the belt, the redwood is almost exclusively confined to the river bottoms and the cañon slopes for a very limited distance up their sides—this marked adherence of the tree to cañon bottoms and their immediate vicinity, at least as regards its heavier developments, being characteristic throughout the belt, but becoming less and less rigidly maintained the further north one goes.*

Starting in lower Sonoma County with mere filaments of redwood, the range of its development, even before passing into Mendocino County, is so much extended that sheltered slopes are clothed with redwood well up to their crests.

Proceeding further northward the areas clothed with redwood become ever more extended and the strictly belt-like character of the zone ever more pronounced. In southern Mendocino we already find a belt of timber, but the effective area of which is much reduced by extensive openings, either entirely bald or only clothed with brush.

Beyond the Noyo River, these openings cease or become so much reduced in extent as not to merit notice, and after passing the Ten Mile River, the belt becomes a continuous zone of timber, extending north to Indian Creek, which stream flowing east and west, nearly corresponds with the northerly line of Mendocino County.

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*The degree of steepness of slope seems in a high measure a determining feature; where the slopes are more than moderately steep the growth is seldom other than a scattered one, while flat benches and plateaus, even at considerable elevations—when not exposed to wind—are generally heavily clothed; a fact probably determined by the degree of thickness of soil deposit, as also the conditions of subsoil drainage. Altitudes as existing within the belt (say up to three thousand feet), seem hardly to be of much moment; the altitude to which the tree will grow being possibly determined by the snowfall more than anything else; places where snow lies to any considerable depth, or for any length of time, being seldom well covered with redwood.

At about this point the south fork of Eel River assumes considerable dimensions, and flowing nearly northward severs the outer range along its axis, into an outer and an inner half. The country near the coast drops in elevation, is drained by rivers flowing directly westward to the sea at right angles to the general trend of the watercourses of the range, and the country so drained is destitute of redwoods, the belt becoming interrupted for a distance of about twenty miles, save for isolated patches but a few square miles in extent, at most.

Redwoods first again appear in numbers on the streams which enter the coast immediately south of Humboldt Bay. These confluent streams, each carrying with it its separate body of redwoods, finally unite to form the large body which centers back of Eureka, and from which point a practically continuous belt of redwoods extends northward, within constantly narrowing lines however, through northern Humboldt and Del Norte, almost to the Oregon line.*

It thus appears that the redwood belt falls naturally into two divisions: a northern and a southern one. Each belt exhibits characteristics peculiar to itself and distinct from the other, differing in growth, development, and character of timber. For convenience in description they will be distinguished as the upper, northern, or Humboldt, and the lower, southern, or Mendocino redwoods, considering the term "Humboldt" generally typical for both Humboldt and Del Norte Counties, and "Mendocino" similarly characteristic of the belt both in that county and Sonoma.

In mere point of development of individual trees, or even of enormous yield of lumber on exceptionally densely covered tracts, no very great contrast presents itself between the two belts. In southern Sonoma County, trees quite as large existed, and isolated acres stood fully as heavily timbered as anything which can be found near the northern limits of the belt. In point of general deneseness of growth, however, the Humboldt belt surpasses that of Mendocino.†

The leading points of distinction between the two belts may be summarized as follows:

For the lower belt, more broken country, steeper slopes, and generally higher ridges than in the upper belt; also a markedly drier climate, and generally more direct exposure to heavy winds. As the result of these conditions, less soft and mellow timber and a smaller percentage of timber clear of knots‡; generally closer grained timber, of slower growth; timber inferior for internal finish, though more serviceable, perhaps, where exposure to alternate dry and moist influences is to be anticipated.

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*The headwaters of Dominie Creek may be considered the practical northern limit of the belt, above which point the growth is very scattered. Redwoods exist in Oregon, but merely as representatives of the species.

† I am indebted to J. W. Bagley, C.E., of Guerneville, for interesting figures, both as to the size of trees and yields of redwood lumber near that formerly famous vicinity. Mr. Bagley measured one tree 349 feet 9 inches in height, and another 19 feet in diameter underneath the bark, and states that the yield of one measured acre scaled in milled lumber 1,431,530 feet, board measure.

‡ As regards percentages of clear—a point upon which so much stress has been laid—the figures for the Gualala Mill Company were 34 per cent in 1884, 30.2 per cent in 1885, while the mills of northern Mendocino produce from 45 to 50 per cent of clear. As high as 70 and 80 per cent is claimed by some of the mills around Mad River, although 60 per cent appears about an average percentage for the Humboldt Bay mills generally. The Crescent City and Smith River mills claim only 20 to 25 per cent of clear. These figures are, of course, only of relative value, the percentage of clear greatly depending upon the price and demand for rough lumber at the time; in other words, how close the lumber is worked for clear stuff. In comparing Gualala with the Humboldt mills, it is to be remembered that the former mill is working over land from which much of its choicest lumber has been cut, whereas the Humboldt mills are all still logging from bottom lands. Twenty years from now their percentage of clear will probably have considerably fallen from what it now is.

In the lower belt, greater restriction of redwood to cañon bottoms and lower hillsides, with but sparse representation on the summits, the slopes, as one ascends, running into Douglas spruce and tanbark oak; consequently a greater percentage of foreign trees for the southern than for the northern belt. Lastly, a diversity in the general disposition of the redwood growth upon the ground, indicating different habits of the tree and varying peculiarities of growth and development, to which subject some reference will be made later on.

From the general description of the redwood belt it will be clearly understood that even within the limits of what must be designated as essentially redwood lands, great variations prevail in density of growth, as determined by location and exposure, apart from the universal disparity which exists in all forests; the heavier growth being confined to certain spots, while those immediately adjacent are practically barren.

Much has been written as to the phenominal timber yields of redwood lands. The yield is in reality unparalleled. Yet fully commensurate with the yield is its shrinkage before reaching the market.

To those conversant with logging operations, the numerous causes of shrinkage in actual production are familiar subjects; to the uninitiated their enumeration (and their number is legion) would be of little interest. Less so, perhaps, the answer to the question: what portion of the standing tree is represented by the product measured at the tail end of the mill? From the best data obtainable, we may place the ratio of product to raw material in the standing tree as about $28\frac{2}{3}$ per cent, or say that for each foot of manufactured lumber leaving the mill, $3\frac{1}{2}$ feet of lumber in the tree is consumed.*

These figures sufficiently establish the fact that the proportion of lumber produced to what might be a fair estimate of the quantities standing in the tree is disproportionately small, and when taken in conjunction with the by no means small percentage of lands capable of producing but nominal yields, leads naturally to the adoption of conservative standards upon which to base estimates of the resource represented by our timber belt. The results of actual milling experience, whenever obtainable, show comparatively modest figures—in relation to which it should also be remembered that the lands so far cut over have always been lands above the average, both in point of density of growth and facilities for successful logging, and that the record of past performances can hardly be a true gauge for the results of a decade hence. Throughout the belt, lands capable of furnishing exceptional yields are always found, but they are no criterion of what the belt taken as a whole is apt to produce.

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*This figure is of interest, having a practical bearing upon other subjects. Its method of determination is here given in some detail as answering a question which has been often asked, but which, I believe, never satisfactorily answered.

The percentage of standing tree (in the column alone; not counting limbs), directly left unutilized in top and stump.................................25 per cent.
(20 to 25 per cent is a generally conceded figure. Some measurements actually made by me, on several trees, would place this item at nearer 30 per cent.)
The loss through breakage in falling, loss of wood burnt accidentally in swamping, allowance for chance rotten spots, and other causes of loss before reaching mill..10 per cent.
Leaving it assumable that there reaches the mill, in the shape of logs.........65 per cent.

Moreover, the percentage of log convertible into lumber, by Spaulding's Scale (assuming them round and perfect logs), is $0.505 \div 0.785 = 63$ per cent.

And the corrective coefficient to render Spaulding's Scale applicable to redwood logs, 70 per cent. (Determined by J. W. Henderson, of Eureka, as the result of actual comparison on several thousand logs actually tested.)

This gives for the net yield, $0.65 \times 0.63 \times 0.70 = 28\frac{66}{100}$ per cent, or conversely, $1 \div 0.28\frac{2}{3} = 3.48$ for the ratio of wood in the standing tree to the actual output of mill.

THE REDWOOD RESOURCE AND THE REDWOOD CUT.

THE RESOURCE.

To clearly define the lands so far cut over and cleared of timber, would, in most parts of the belt be impossible, its exterior lines differing to-day but little from what they were when the lumberman first commenced operations. Proceeding along the streams, always taking what was most accessible and selecting the best lands, the belt has been honey-combed, but little reduced in absolute area. Here and there, where the mills have clustered very thick, strips might be segregated from the body and classed as cleared; but generally speaking, to attempt to show in map form the extent to which exploitation has been carried, would fail; either conveying an exaggeration or an understatement of the facts, according as lands only partially worked over were embraced in or totally excluded from the clearings. That the attacks upon the belt have not been insignificant, may be inferred by the distance from which logs are often transported to the mills. The Mendocino Lumber Company's advanced logging camps are twenty-nine miles from the mill (by water), and the Albion Mill draws its logs about nineteen miles, of which four and one half miles by rail, in two stretches, with fourteen miles of intermediate water transportation. Higher lying lands have been little drawn upon as yet, save for supplies of ties, posts, shake-bolts and the like split material. Here the settler working his own timber has effected wholesale destruction with his frow and ax, chosing only the most promising trees and utilizing but the freest-splitting portions of these, and often leaving the tree entire waste, if its grain proved refractory or its texture "flinty." The waste has been enormous.

Various attempts have been made to determine the timber resources of the belt. The best of these—that made by Mr. John Dolbeer and submitted to Col. R. S. Williamson, United States Engineer Corps, in 1880—certainly possesses the merit that it embodies the ideas of many of the prominent mill owners along the coast, which entitles it to consideration. This estimate has been already published in several official publications, and it is given below, should an interest be found in comparing it with the estimate now submitted to the Board.*

*Estimate of John Dolbeer, Esq. (of Dolbeer & Carson), of the amount of redwood standing, 1881. (From a letter addressed to Col. R. S. Williamson, United States Engineer Corps, *dated March 15, 1880*):

From Russian River to Cottonavia Creek	7,680,000,000
From Cottanavia Creek to Eel River	50,000,000
On Eel River and tributaries	5,000,000,000
On Humboldt Bay	1,920,000,000
On Little River and Mad River	4,000,000,000
From Little River to Big Lagoon	2,500,000,000
On Redwood Creek and tributaries	2,500,000,000
On Klamath River and around Crescent City	----------
Total	23,650,000,000

Mr. Dolbeer also estimates the consumption of redwood at:

Sawed lumber	120,000,000
Railroad ties	30,000,000
Posts	9,000,000
Shingles and shakes	12,000,000
Total	171,000,000

This estimate bears also, in indorsement of it, the signatures of the Mendocino Lumber

The lumber resource concentrated in the redwood belt being the most important in the State, both on account of its magnitude and accessibility, and probably quite equaling in productive power of merchantable lumber at least that of all the balance of the State combined, accurate information concerning its extent, character, and probable duration was considered of importance to the Board of Forestry. The defining lines of the belt have never been traced before with any attempt at detail, nor the effective area of redwood land determined, save by rough approximations, based upon assumed widths of the belt, the results of which approximations never failing to leave the impression that the estimate above referred to stated but a fraction of what the belt might be relied on to produce.

The actual resource will, as a matter of course, never be known, save as an approximation, and the figures submitted only claim consideration above those made by others, inasmuch as they were made on the ground, with a correct knowledge, at least, of the area of the belt (to determine which the special knowledge of almost every local surveyor was drawn upon), the experience of the mills and their actual performances utilized, wherever determinable; and no known source of information was left unconsulted that might serve to determine the special character of the belt at its different points. For this information the views of professional timber experts, owners, surveyors, and assessing officers were gathered by personal consultation, aided generally by township plats which were at hand.

That to raise information drawn from so many and such different sources above the level of mere compilation, the writer's personal views could not fail to materially color the whole, is evident. The figures are believed to be conservative, and care was taken to be within rather than above the actual facts. For this no excuse is pleaded, experience having well established the fact that few professional timber experts ever set figures low enough to meet the actual yields when practically tested; and the fact has not been lost sight of that our average present practice utilizes considerably less than one third of the standing tree, not taking account of timber too defective to be suitable for cutting, or which, when cut, is unfit to go to mill.

Together with the yields given first by natural subdivisions (similar to the estimate of Mr. Dolbeer), and afterwards by counties, are added the acreage of what was considered effective redwood land, even though sparsely clothed. Figures are also given showing the range between which the bases upon which the partial estimates never covering more than a few thousand acres at the outside (and not shown in the report) were made; also the acreage of lands whose yields were considered nominal, and which must be taken into consideration in criticising the *average yield* per acre for the different counties (which was simply obtained by dividing the total yield by the effective total acreage) which, from the explanation first made in this subdivision of the report has, to a great degree, been affected by the influence of the portions of the belt already cut, and perceptibly also by the consideration that while no portion of the belt can be to-day considered inaccessible, *i. e.*, too inaccessible to be stripped of timber eventually, still highlying and outlying tracts will be hardly likely ever to yield the fair quota which they might be expected to produce if otherwise located; their method of stripping promising to be either effected by less economical methods, or at least coupled with greater care in selecting and taking

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Company; H. B. Tichnor & Co., of the Navarro Mill; J. G. Jackson, of the Caspar Mill; S. H. Harmon, of the Gualala Mill; F. P. & J. A. Hooper, of the Trinidad Mill Company; J. Kentfield & Co., Eureka; J. Russ & Co., Eureka; McPherson & Wetherbee, of the Noyo and Albion Mills.

to the mill only the best timber, than would be the case were they more accessible and capable of being logged at less expense. These reservations and exceptions alone excepted, the figures are designed to cover the whole redwood resource of the belt.

The resource as first presented is subsequently modified by deduction for portions of the total cut not allowed for in the original calculation, and after deducting which the residual quantities present for the different counties the resource as it may be considered at present.

TABLE A.

Estimate of Standing Redwood in Del Norte, Humboldt, Mendocino, and Sonoma Counties.

1. LOCALITY—COUNTY.	2. Acres of Effective Redwood Land.	3. Estimated Capacity Board Measure.	4. Average Yield per Acre; Column 3 Divided by Column 2.	5. Acres Sparsely Clothed with Redwood 15,000 Feet per Acre and under.	6. RANGE. Yield Used in Partial Estimates (not shown). Minimum.	6. Maximum.	7. Portion of Estimated total Cut to be deducted from Column 3. (See Table B.)	8. Estimated present amount of Standing Redwood. Feet Board Measure.
North of Smith River	29,565	519,825,000						
Smith River to Klamath River	56,604	2,096,342,000						
Del Norte County	(86,169) say 86,000	2,616,167,000	30,362	30,720	5,000	60,000	61,150,000	2,555,017,000
Klamath River to Mad River	208,699	7,549,261,000						
Mad River to Van Dusen River	143,460	5,719,950,000						
South of Van Dusen River to Mendocino County line	92,494	3,994,642,000						
Humboldt County	(444,653) say 444,600	17,263,853,000	38,830	62,000	15,000	125,000	1,112,000,000	16,151,853,000
From Humboldt County line to Ten-Mile River	142,414	3,972,420,000						
Ten-Mile River to Big River	147,731	4,431,930,000						
Big River to Gualala River	139,696	3,890,880,000						
Mendocino County	(429,841) say 429,800	(12,295,230,000) say 12,295,000,000	28,600	72,400	15,000	50,000	1,343,000,000	10,952,000,000
Sonoma County	41,700	980,000,000	23,500	11,200	10,000	45,000	140,000,000	840,000,000
	1,002,100	33,155,020,000		176,320			2,656,150,000	30,498,870,000

RESUME.

Total acreage of redwood lands	1,002,100
Deduct lands very sparsely clothed	176,300
Acreage of good and fair lands	825,800
Total standing estimated amount of redwood, feet board measure	30,498,870,000

THE REDWOOD CUT.

Records of the quantity of redwood taken from the belt exist only in the most fragmentary and disconnected form, and are not sufficient to determine the cut with precision. However, utilizing all the data which diligent search unearthed; from records where they existed, from the best traditionary evidence where no records could be procured, it would appear that the following statement may not be far astray: *

TABLE B.

Estimated Total Cut of Redwood to date in Northern Redwood Belt.

County.	Lumber Sawed by Mills. Ft., Board Measure.	Shingles. Reduced to Ft., Bd. Measure.	Posts. Reduced to Ft., Bd. Measure.	R. R. Ties. Reduced to Ft., Bd. Measure.	Total Estimated Cut.	Cut from Belt, as defined in Estimate. Correction used in Table A, Col. 7.
Del Norte	59,400,000	1,750,000			61,150,000	61,150,000
Humboldt	1,416,000,000	83,250,000	35,000,000	32,000,000	1,566,250,000	1,112,100,000
Mendocino	1,424,000,000	56,000,000	52,000,000	224,000,000	1,756,000,000	1,343,000,000
Sonoma	697,000,000	42,000,000	18,000,000	64,000,000	821,000,000	140,000,000
	3,596,400,000	183,000,000	105,000,000	320,000,000		
Total					4,204,400,000	

The total estimated cut has been figured out as 4,204,400,000 feet, which, if all the wood used for shakes to build settlers' improvements (and which never have shown up in any records) were included, allowing for the waste such use always is accompanied with, would probably swell the total cut from the upper belt to at least 5,000,000,000 feet of lumber, or its equivalent.

As has been stated, no record of the cut was kept in the earlier years of redwood lumber operations. We are, however, thanks to Mr. E. L. Allen (Secretary Redwood Manufacturers' Association) enabled to furnish figures covering the estimated production of sawed lumber for five years back, which may serve to illustrate the tendency towards increase which the market is developing.

* Statements of the quota which each mill had furnished (as well as might be now determined) were obtained; the output of old dismantled mills determined by information gathered on the ground from persons conversant with the mills and their markets in years past. Such items as ties, shingles, and posts were arrived at by estimating the consumption, as indicated by the best preserved records, the same data, when covering several years, supplying the means of approximating the percentage furnished by each county, from which the final distribution was made. The items have been kept separate, to court corrections, if better information exists in some unknown quarter.

TABLE C.

Showing the Total Estimated Consumption of Redwood Lumber for the five years, 1881–1885.

Year.	Production. Feet, Board Measure.	Increase. Feet, Board Measure.	Decrease. Feet, Board Measure.	Per cent.	Remarks.
1881	130,465,714	....	....	......	Does not include Santa Cruz and adjacent counties; local consumption.
1882	152,517,738	22,052,024	....	$14\frac{5}{10}$	Does not include Santa Cruz and adjacent counties; local consumption.
1883	250,000,000	72,482,265	....	$\frac{32}{100}$	Includes Santa Cruz and adjacent counties. In this year Southern California took 72,000,000 feet. Santa Cruz and adjacent counties consumed 25,000,000. Apart from these items the consumption was virtually steady.
1884	208,455,000	....	41,545,000	$16\frac{2}{3}$	During this year shipments to Southern California dropped off to 35,000 and Santa Cruz' consumption is stated at only 3,000,000 feet. Independent of the influence of Santa Cruz and Southern California, consumption increased 11 per cent.
1885	215,000,000	6,545,000	....	$3\frac{1}{7}$	

The table shows that apart from the shipments to Southern California and the Santa Cruz consumption, both of which appear to have fluctuated widely, the tendency has always been upward and the increase considerable; the average annual percentage of increase having been seven and one quarter per cent.

Records of the consumption of the San Francisco market, and that of points directly drawing their supply from San Francisco (for sawed lumber alone), have been systematically kept since 1863. These figures are added, as also such fragmentary memoranda as are at hand, concerning the production of lumber of the several counties, and which may serve to throw some light upon the development of the redwood market.

TABLE D.

Embodying past records of production for various parts of the belt; showing the consumption of Redwood Lumber by the San Francisco markets, and shipments to foreign ports.

YEAR.	Consumption of San Francisco Market—Sawed Lumber only. Ft. Bd. Measure.	Del Norte County.	Humboldt County. Sawed Lumber.	Mendocino County.	Sonoma County.	Foreign Shipments.
1860			9,575,000			
1863	43,022,597					
1864	41,591,177					
1865	53,097,753					
1866	60,174,310		[1]27,648,000 [2]34,961,916			
1867	66,665,954					
1868	84,754,183					
1869	81,899,095					
1870	87,706,213		[1]27,648,000 [2]34,977,700			
1871	75,295,952					
1872	89,782,618					
1873	73,870,244		[2]50,764,224			
1874	95,545,490					
1875	110,231,073					
1876	113,011,014					
1877	107,330,749					
1878	92,327,814					
1879	88,121,653					
1880	80,731,664					
1881	93,565,989					[1]7,000,000
1882	94,606,063					
1883	103,195,515	[1]4,262,740	[1]79,815,646	[1]77,905,717	[1]18,948,459	[1]10,000,000
1884	103,941,105					[1]17,000,000
1885	115,253,922	4,050,000	82,300,000	74,050,000	4,400,000	[3]10,200,000
Total	1,955,722,147					

1. Sawed lumber. 2. Including shingles, ties, and posts, but not local sales of sawed lumber. 3. Shipments:

To Mexico, Central, and South America	950,000
To Islands of the Pacific	2,650,000
To Australia	5,950,000
To Europe	650,000

THE ANNUAL CONSUMPTION OF REDWOOD AND PROBABLE DURATION OF THE BELT.

The figures shown in Table C warrant one in assuming that the prospective consumption of sawed lumber will hardly fall short of that of the year 1885, say 215,000,000, to which in estimating the total consumption must be added the production of the sundry items other than sawed lumber, and which may be stated to run, one year taken with the other, about as follows:

Railroad ties—equivalent in feet board measure	*15,000,000
Posts	†12,000,000
Shingles and shakes	12,000,000
	39,000,000
Making, with the consumption in sawed lumber	215,000,000
A total of (feet board measure)	254,000,000

And if these figures are a correct gauge of the future, the duration of the redwood might be set at about one hundred and twenty years.

What its duration will eventually prove, is a matter difficult to predict, the consumption being materially influenced by several modifying causes and the relation between supply and demand not altogether a simple one, at least as regards the home market.

To the creation and development of outside markets it is, however, that one must mainly look for material increase in the redwood cut, and the attention of our redwood manufacturers is largely directed towards developing new fields outside of the home market. Drying houses, to render the lumber capable of cheaper transportation, are being introduced; railroads having direct connection with transcontinental roads (and which will open to exploitation portions of the belt now virgin), promise to be constructed within the near future. The intrinsic merits of redwood lumber, when thoroughly appreciated abroad, and the rapid exhaustion of the timber resources of the Eastern States, are other causes promising a considerable increase in the annual cut of redwood.

As regards the home market, the increase will, for a time at least, be probably only that due to the increase in population and accumulated wealth of the State. The redwood has always been a relatively high priced wood; its cost of production (delivered in San Francisco), generally having been above that which pine (Douglas spruce) lumber, shipped from Oregon and Washington Territory, could be sold for, and the consumption of redwood has always more or less been gauged by the ratio of its market price to that of other lumbers; the uses to which redwood was applied somewhat varying with its price.

The aggregate productive capacity of the mills has always been approximately twice the actual output; the absorptive capacity of the home mar-

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* This item was set by Mr. Dolbeer at 30,000,000 feet. Our figure it is believed fully covers the present average annual consumption in ties, but a few years hence Mr. Dolbeer's figures are liable to be nearer correct. From the mileage of railroad track equipped with redwood ties, and of which a major portion has been built less than twelve years (which is the average life of redwood ties), one may assume that the consumption for repairs alone will, a decade hence, have reached Mr. Dolbeer's figure. We leave it, however, at 15,000,000.

† The posts received in San Francisco in 1884 were 1,794,000, which at 14 feet board measure per post, equals 25,116,000 feet board measure.
The posts received in San Francisco in 1885 were 893,000, which at 14 feet board measure per post, equals 12,502,000 feet board measure.
We take the lowest figure, say 12,000,000, as the average consumption.

ket for building lumber of all kinds more than double that of the redwood consumed—but the balance of cost of production is always against redwood and in favor of other woods. Under these conditions constant over-production has prevailed, and only through combination has a market been sustained at all. A valuable resource—purely Californian, the real value of which will only be known when the resource is nearly exhausted—is rapidly melting away, and going, too, without adequate return to the financial prosperity of the State. New mills are being constantly added to the already more than abundantly sufficient number, and amelioration of the condition of the industry is mainly to be expected from foreign demand.

As an offset, however, to the causes tending to decrease the duration of the belt, as gauged by the present cut, the promise exists of a more conservative spirit appearing, as the redwood becomes scarcer and centralization of ownership into a few hands renders control of the market possible, when redwood may be considered too choice a wood for many of its present purposes. These tendencies and the higher efficiency in productive methods which higher prices are liable to bring in their train, may tend to prolong the life of the redwood a few years beyond the period which, under the influences tending to increased consumption, it might otherwise be reduced to.

At a rough guess, everything considered, the redwood is not liable to be exhausted in less than seventy-five to eighty years; nor does it promise to last much more than a century.

THE EFFICIENCY OF REDWOOD LOGGING AND MANUFACTURE AS AN ART.

The term "efficiency," as we shall have occasion to use it in connection with logging or manufacture, may be defined as *the percentage of raw material in the standing tree converted into some commercially valuable product.*

To go into details and attempt a description of the peculiarities of redwood logging and manufacture as at present conducted, interesting and worthy of notice as the subject in itself is, would lead us from issues of forestry into matters of mainly technological interest. We can only attempt to briefly notice such points as have a material bearing in shortening or prolonging the life of the redwood belt as a forestal resource, which is only another term for "efficiency," as above defined.

The amount of waste made in redwood manufacture has been already noticed as something enormous, being, according to the general average present practice, as well as we have been able to approximate it, a fraction over 71 per cent.

Perhaps never clearly defined as a mathematical ratio before, the fact has always been patent that only a small portion of the raw material in the tree found its way into marketable products, and insensibly perhaps the inference drawn that this was all more or less chargeable to the inefficient methods of the manufacturer.

Closely considered, it will be found that he is responsible only for a very small portion of this large shrinkage. As might be presumed *a priori* the lumberman has ever been concerned to produce as much clear product as possible from the raw material handled, within the limit of reaping the largest possible return upon invested capital; he has exercised that degree of economy which the general conditions under which he has labored admitted of, and it is due to his efforts solely that year by year the standard of efficiency of his art has crept up gradually from the lower standard that it was to the standard of to-day, which is no longer a low one, when gauged by the probable limit which he may hardly ever expect to surpass. If we are right in setting the present efficiency at about 28 per cent, there is equally good reason for believing that in the infancy of the lumbering art the efficiency was hardly more than 20 per cent, and it may be pretty confidently asserted that the extreme limit of efficiency which he may ever hope to attain will not exceed 40 per cent, unless time and increasing scarcity of lumber should develop a demand for portions of the tree at present unmerchantable.*

The proposition has been dryly stated; yet nude figures best serve to correctly define the present state of the art, and also, which is of equal importance, to establish conclusively the fact that mere increase in efficaciousness in manufacturers' methods can only hope to extend the duration of the redwood belt to a limited degree.

To show how slow the march of progress is, let us—still adhering for awhile to dry figures—consider to what extent the introduction of the

* Not to overload our subject with dry figures we omit a demonstration of these ratios. Their proof is, however, given in Appendix A.

bandsaw, one of the most radical changes ever proposed in manufacturer's methods, in connection with the redwood, may be expected to raise the present standard of efficiency. The bandsaws now used (by a few of the more progressive mills only), makes a curf (cut) of about $\frac{1}{12}$ of an inch. The curf of the large circular saws is about $\frac{3}{8}$ of an inch. The difference between the two saws is immense ($\frac{3}{8} \div \frac{1}{12} = 4\frac{1}{2}$), and if this were a true gauge of the saving effected in actual practice, there might, indeed, be cause for congratulation. With saws making $\frac{3}{8}$ inch curf, the percentage of sawdust made, may, under extreme conditions, amount to over 40 per cent of the lumber sawed. In actual practice, the sawdust generally made (sawing lumber, thick and thin, to meet the call of the market as the demand usually runs—using "pony" and other saws in conjunction with the circulars), may not exceed 25 per cent of the lumber sawed. The bandsaw, used to the extent to which it is usually proposed to apply it, may reduce the amount of sawdust made about 50 per cent. The lumber made by circular saws being, say $28\frac{5}{8}$ per cent of the raw material in the tree, we have for the average percentage of tree converted into sawdust 25 per cent of $28\frac{5}{8}$ per cent $= 7\frac{1}{8}$ per cent, and by bandsaws 50 per cent of $7\frac{1}{8}$ per cent $= 3\frac{1}{2}$ per cent (about), which would make the efficiency of manufacture by bandsaws, $28\frac{5}{8} + 3\frac{1}{2} =$ say 32 per cent.*

In whatever there may be cause to lay the charge of wasteful methods and ruthless sacrifice of timber to the lumberman's door, it may be well to remember that for the unknown redwood a market had to be created, and that to subjugate these giants, special methods had to be devised. Small wonder that, in the hands of novice workmen, trees 300 tons in weight (without counting limbs or boughs), proved tough subjects, or that single logs of 35 (yes, not seldom 60) tons were weighty things to handle, and that to dissect them much hacking were required. When carefully considered, to merely move such weights must have been a problem of no small difficulty, and with the primitive appliances of pioneer days it must indeed have taxed to a high degree the resources even of an ingenious class. Beset by difficulties such as these, no wonder that waste was great. Step by step progress has been made—at first slow, afterwards more rapid; new appliance after new appliance was introduced; new schemes and new wrinkles devised, until to-day redwood lumbering has become what it now is—an art in itself. A resource, which in those days, in a State but thinly settled, appeared exhaustless as the ocean, has gradually attained to partial recognition. The day is coming when the raw material in the tree will be considered capital, and as such, husbanded and guarded. To-day its value in the raw state is nominal, its price in the market determined by cost of production mainly—timber lands still being held at but nominal figures, available timber lands constantly changing hands at prices corresponding to not over 20 cents per 1,000 feet of lumber capable of extraction. This figure may at present fairly represent (probably more than represents) the intrinsic value of the "nettable" redwood in the raw.†

*This, we know, is not putting the facts in the most favorable light for the bandsaws. We by no means wish to imply that bandsaws may not increase the net yield of lumber from any given log, by say $12\frac{1}{2}$ per cent, which is quite in conformity with our other figures. We have seen some of the finest and most even lumber anywhere inspected, cut by bandsaws, and we heartily hope to see them universally introduced. Since railroad logging superseded water transportation, no such promising step has been made as the proposed introduction of the bandsaw.

† Stumpage ranging from $1 to $2 per 1,000 feet at the outside has been paid for years past, it is true. Yet whether this figure can be considered as having ever represented anything but the premium arising out of the greater accessibility of certain spots on which the lumber chanced to stand is questionable. In past years, at least, where stumpage was paid it may safely be considered as having only been as an offset against reduced transportation charges.

Let the past remain what it was. At present the whole tendency throughout the belt is towards economy. As timber lands are becoming scarce and hard to obtain, their timber is becoming prized. The mills of to-day are revelations to the novice, and there are many at which no end of pains is taken to promote the small economies. Mill after mill emulates another in devising new specialties of manufacture whereby waste odds and ends of lumber, which formerly went to the waste pile and were burnt, now are worked into shape to fill some useful purpose. Grape boxes are now made of redwood, the sides and bottoms of which formerly would have been burnt—the ends have to be made of choice lumber. Shingles and shakes formerly either split or sawed from bolts selected from the best of timber, now are very generally sawed from outside slabs, otherwise refuse. Pickets, likewise, and short lengths of board (three and four feet and upwards), which formerly would have received no notice, are sawed into even lengths, tied in packages, and shipped to market as "panel stuff."

These items, all small in themselves, and probably in bulk but increasing the percentage of raw material utilized to a very small degree, still show the drift of the times; as at the mill, so also in the logging camp the set tendency is towards care.

To-day, so far as the redwood—*at least*—is concerned, there can be little just charge of needless waste. With woods of other trees the matter stands far differently. The Douglas pine meets some slight grace, to the extent of being cut and utilized when of good quality—the chestnut oak is stripped of its bark at least, even though the wood go to waste. As to the other trees, they go, not by the steel but by fire;—burnt at the root, scorched in the bark, they wither and die—remaining standing for a time, until they fall to pieces from rot, or robbed of their natural shelter, they are blown over by the winds. Much to be regretted as this may be, the reason why these woods are going to waste without any attempt being made to utilize them, is simply that under the present conditions there is no demand for them at prices which will pay to manufacture them into lumber. The supply of other more desirable woods is so great, and the price of them so little above their cost of production, that inferior woods, however good in themselves, are excluded from market.

THE REPRODUCTIVE CAPACITY OF THE REDWOOD.

Our investigation of the acreage of the redwood belt, and the timber resource contained in the same, naturally led to large figures, but also establishes the fact that even at the present rate of consumption no very great number of years will elapse before the resource will be exhausted. This naturally suggests the inquiry: "To what extent may an aftergrowth be relied on as a means of restocking the belt, and what period would be required to develop trees suitable for profitable sawing?"

The conclusion which has forced itself upon the writer, after careful survey of the ground, is that to no considerable extent is an aftergrowth of redwood to be expected at all. The conviction, amounting to certainty in the writer's mind, is, that although the redwood, as a species, will probably never die out entirely, it is never likely to attain to heavy development again, and that practically speaking, the present resource is all that can be counted on.

In mere point of power to successfully resist the hardest treatment which the elements can subject it to, no tree can surpass the redwood; nor, as simply characterizing this peculiar capacity, could its botanical name have been more fitly selected, yet the writer has failed to find the first acre of cleared ground which promised to become a growth of trees worthy of the name, even where fires had been kept out and the location was a sheltered one. Opinions differing with this view have been frequently asserted and found expression in official publications, which should be authoritative, yet it is believed that mere power of resisting destruction has been confounded with the widely different one—the power of reproduction.

Before attempting to ground this view, it may be as well, however, to consider some of the typical forms under which the tree is found growing in nature. We note what we consider the types, as also such inferences as to age and manner of growth as observation suggests:

Type 1. Trees of mammoth size, thickly aggregated, yet uniformly distributed over the surface. Long clear shafts. Trees characteristically healthy looking, and foliage well developed—so thickly often as to exclude the sun's rays, save when the sun is near the zenith. Ground clear from all underbrush, fernbrake at most covering the ground; but more often, where the growth is very dense, nothing but a carpet of leaves. Now and again the shafts show fire marks on bark; burnt and charred stumps, however, phenomenally absent; complete absence of all trees of young growth, or even growth differing much from the general uniform standard, and no foreign woods at all.

This type characterizes flats and river bottoms—especially streams tributary to Eel River, and generally the heavily timbered bottoms of Humboldt County and Del Norte.

Type 1 is eminently suggestive of primeval growth; no vestiges of an older growth being anywhere discernable. Probably developed from seed.

Type 2. Trees also uniformly distributed, and an apparent growth from seed, but size generally only moderate, and not colossal; distribution open and scattered, often collected in groups, but not in a manner indicating an aftergrowth from a common source. Trees of slower growth than in type 1, but probably of not less age; characteristically the growth of the

lower (Mendocino) belt, corresponding to type 1 further north. Young trees rarely common; but foreign families well represented, especially on sidehills, where the redwood is more strung out.

Type 3. Trees often of great size, and individually often as fine specimens as those of type 1, although more often trees of only moderate height. Differs from types 1 and 2 purely in point of trees being always or at least, characteristically close clustered in groups, often around one central tree of greater age than the rest; oftener the parent tree destroyed and only the charred stump remaining. Always so distributed, however, as to suggest a secondary growth, not from seed but a sucker growth. Type 3 especially common in southern Humboldt, south of Garberville, where the Humboldt belt comes in.

Type 4. Trees evenly distributed, but growth generally thick. Trees of all sizes intermixed—from saplings up to well matured trees, the younger trees characteristically tall and slender. Specimens 4 to 6 inches in diameter are often 70 to 80 feet high, with no foliage save near the tops, the whole energies of the young trees being centered in attaining height and sunlight. This growth is a scarce one, and only characteristic in spots from Little River (Humboldt County), north, to the Klamath River, but especially near Prairie Creek. Foreign woods (Douglas and Menzies spruce and White fir) well interspersed with the redwood. Type 4 is the solitary instance of a redwood forest in course of natural replenishment; trees of all ages growing in the same forest occur often mixed with type 3.

Type 5. Trees thickly aggregated, yet not clustered; *of uniform size and young growth*. Evidently a young and new forest sprung up spontaneously from seed. A very rare growth, only noted on low and moist lands. Can be seen well developed on road from Crescent City to Smith's River Corners. Young hemlock well represented with the redwood growth.

These have been given as types, and localities even mentioned. That the different types merge and run into one another is self-understood, and often within a few miles of one another several of the types will be seen. More frequently, however, a combination of two or sometimes three types will characterize a considerable district.

Of the five types enumerated, two (they are uncommon ones, by the bye) show the growth of young trees progressing before our eyes, and a third suggests, at least, the growth of a secondary forest by sucker growth; and all three might be instanced in support of the probability of our belt restocking itself as the present growth is being cut out.

There is no question but that forests have grown and passed away, and been succeeded by new forests, and this may have been going on for ages.*

However, whatever the redwood may have done in the seclusion of its natural haunts, under the lee and shelter of standing timber—consequently under the same conditions that standing trees flourish under—it may fare widely otherwise with it under such conditions as it probably will be subjected to in the clearings left by the logger. It is often urged that time sufficient has not elapsed to warrant the expectation of finding trees of any size as yet. This is quite true, and it is not that young redwood trees of fair size cannot be instanced at all; it is rather because they

* That the redwood is a tree of immense age is unquestionable, excavations often unearthing specimens of redwood at very considerable depths. The writer has in his possession two samples of redwood taken from a tunnel run through "Table Bluff" (near Eureka), both in a state of excellent preservation, the one having been encountered 550 feet, the other 800 feet, from the nearest tunnel ends, and both at a depth of 200 feet below the surface. This is but another instance of the wonderful durability which the tree, or at least certain portions of it, reveals.

can be found grown to fair size (say up to 20 inches in diameter and 60 to 70 feet in height, which even now might furnish timber for some purposes) *but only as cases of rare exception*, that there appears so little promise of any considerable aftergrowth succeeding our present forests. One may hunt over many acres of logged ground and not find one of these promising specimens. For the rest, where the logged grounds are left uncared for, one finds thousands of sprouts and suckers clustering about the old stumps and their more immediate vicinity (smothered generally among underbrush), but nowhere showing promise of a widespread and a uniform growth, if even a slow one.

What artificial protection and care might do towards fostering an aftergrowth there is no means of determining, but it is safe to say that the generally prevailing conditions throughout the belt are not likely to be those of fostering care. Whatever aftergrowth is developed will probably be under direct exposure to the sweep of the storm, and probably exposed also to the periodical visits of fire, enough in themselves to check all development.

It is, however, not necessary to obtrude personal views to establish the point that little is to be expected from future growths of redwood. We may go to the living tree to determine what growth might, under the most favorable circumstances, be expected (say from the saplings now started) by the time our present supply promises to be exhausted, from which we may judge whether, practically speaking, there are grounds to warrant us in placing much reliance on the future growth.

It may be stated in general terms that, as one proceeds northward in the belt, the growth of the redwood—for trees grown under relatively similar conditions—becomes constantly more rapid up to the point where the tree gives out. In Mendocino County 300 rings can often be counted upon logs 30 inches in diameter, while in the vicinity of Smith River we have notes of measurements made on two trees, the one with a diameter of 5 feet 10 inches, showing 189 annual rings (length of tree unknown), the other, of which we have fuller measurements, with a diameter of nearly 6 feet (measured 9 feet above the ground), showing 214 rings. Both these trees are of phenomenally rapid growth. The measurements made upon the second tree are given in tabular form in Table E:

TABLE E.

Illustrating the Growth of Redwood on Smith's River, Del Norte County.

A. Measurements upon butt log, 9 feet above surface of ground.

Age of tree—years.	The tree had attained a radius—*i. e.*, distance from heart to bark of—feet.	Growth—increase in semi-diameter.	Interval—years.	Rate of growth per year in one-thousandths feet.	Remarks.
30	0.46	0.46	30	$15\frac{1}{3}$	
40	0.59	0.13	10	13	
60	0.97	0.38	20	19	
70	1.20	0.23	10	23	
80	1.42	0.22	10	22	
90	1.61	0.19	10	19	
100	1.79	0.18	10	18	214 annual growths, maximum radius, 2.95 feet; minimum radius, 2.53 feet. Heart wood.
110	1.93	0.14	10	14	
120	2.05	0.12	10	12	
130	2.12	0.07	10	7	
140	2.18	0.06	10	6	
150	2.24	0.06	10	6	
160	2.29	0.05	10	5	
170	2.34	0.05	10	5	
180	2.39	0.05	10	5	
190	2.44	0.05	10	5	Semi-sap wood.
200	2.495	0.055	10	$5\frac{1}{2}$	
210	2.535	0.04	10	4	Sap wood.
214	2.57	0.035	4	$8\frac{3}{4}$	
....	....	2.57	214	....	

Miscellaneous Memoranda.

NOTE.—*Measurements, 79 feet from butt cut* (*i. e.* 79+9—88 feet from ground); maximum diameter, $4\frac{1}{2}$ feet; minimum diameter, 3.9 feet.

Measurements, 96 feet above butt cut, or 105 feet above ground; maximum diameter, 3.7; minimum diameter, 3.6 feet. At this cut, wood bleached and light red in color. At 106 feet, first protruding knot was observed.

At 112 feet 9 inches from butt cut (*121 feet 9 inches from ground*); maximum diameter, 3.35 feet; minimum diameter, 3.25. (Between this section and the following, timber knotty.)

B. Record of Ring Measurements 129 feet 3 inches above butt cut, or 138 feet 3 inches above ground.

Age of tree—years.	Radius—feet.	Growth—feet.	Period—years.	Average annual growth in one-thousandths feet.	Remarks.
0	....	....	....	....	
10	0.21	0.21	10	21	
20	0.40	0.19	10	19	
30	0.57	0.17	10	17	
40	0.73	0.16	10	16	
50	0.86	0.13	10	13	
60	0.97	0.11	10	11	Heart wood.
70	1.09	0.12	10	12	
80	1.21	0.12	10	12	
90	1.25	0.04	10	4	
100	1.29	0.04	10	4	
103	1.30	0.01	3	$3\frac{1}{3}$	
155	1.42	0.12	52	$2\frac{4}{5}$	Sap wood.
....	....	1.42	155	....	

Miscellaneous Memoranda.

Above this point 77 feet of knotty lengths and 20 feet of broken fragments, the last still 5 inches — 0.42 feet diameter, or 0.21 feet radius, representing say 10 to 15 feet of growth

lacking, which would make the height the tree had attained when cut 129′ 3″ + 97′ = 226′ 3″ + 15 feet (estimated) = 241 feet, or in all 250 feet from ground.

DEDUCTIONS FROM ABOVE DATA.

Height of tree, say 250 feet; age when cut, 214 years; average linear growth, $\frac{250}{214}$ = 1.166 feet.

Comparison of Tables A and B.

Age of butt-log section (Table A)	214 years.
Age of section (Table B)	155 years.
Difference	59 years.

By reference to Table A, we see that at 60 years the tree had attained a radius of 0.97 feet, or a diameter of say 1.94=2 feet, practically speaking. This tree would scale (by log scale) 855 feet, board measure, assuming the tree to have been one foot thick at 60 feet from base, and that it furnished logs up to that height. The tree at 214 years (as the logs lay on the ground) scaled a yield of 13,391 feet, board measure.

The average annual yield in lumber for the tree up to 60 years of age is therefore $\frac{855}{60}$ = $14\frac{25}{100}$ feet board measure, while that for the tree when cut (214 years old) was $\frac{13391}{214}$ = $62\frac{58}{100}$ feet, board measure. From which it is easily seen that as a producer of lumber the tree at 214 years of age had produced (62.58 ÷ 14.25 =) $4\frac{4}{10}$ times as much lumber for each year of its growth as it had done previous to its attaining its sixtieth year, disregarding the difference in quality of the lumber produced.*

These figures illustrate how important a factor age is, where the production of wood in quantity is the object. Where quality is sought, the same superiority in favor of older growths, up to the age of maturity, is always observable, and this applies not to the redwood only, but to trees in general. In fact we have the assurance of Baron von Muller that the eucalyptus even cannot be relied upon to yield timber fit for sound plank under fifty years.

Where the production of shade and the development of leaf surface are the prime desiderata, the importance of tree planting cannot be overstated, yet the fact should not be lost sight of that forests such as at present adorn and characterize our State cannot be reproduced by forced growth. They are the work of nature operating through ages; they are the survivors among the hosts which have perished. To reproduce them is no work for man, and, once gone, who shall see their like again?

In making estimates of the probable duration of the present stock of redwood, it was stated that the supply could hardly be counted upon to last more than a century. Judging from the records contained in subdivisions A and B of Table E, at the age of one hundred years, the tree to which these measurements refer would have attained considerable dimensions, say a diameter of 3 feet 7 inches, nine feet from the ground by 18 inches at a height of one hundred and thirty-eight feet. This tree, which would scale 5,723 feet (by $\frac{3}{4}$ log scale) and which would probably produce 4,000 feet under the saw, would be by no means beneath the notice of lumbermen, especially in an exhausted belt, and, were the growth recorded in Table E an ordinary one, might really attest to trees attaining sufficient size within a century to make them valuable for lumber. It has, however, been already stated that growths like that of this special tree are exceptional; lower in the belt there are places where trees three times the age of this one would not have attained to similar size.

These are the facts, and they are recommended to the special consideration of those who have prophesied bright things for the future redwood. All things considered, there is no tree which exhibits such wonderful ability to resist destruction, but which promises less for a second growth:

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* It may be claimed that the standard of comparison selected, *the capacity for yield of lumber* has been an unfair one for the young tree; that the efficiency should have been gauged by the quantity of wood annually produced. This places the matter, however, in a light but little more favorable for the young tree. Similar calculations based upon the mere wood producing capacity of the two trees give for the average annual production of the young tree 2080 ÷ 60 = $34\frac{67}{100}$ feet, board measure, and for the tree at 214 years of age, 25647 ÷ 214 = 120 feet, or for the relative efficiency of the older tree above the younger one 120 ÷ 34.67 = 3.45 (as against $4\frac{4}{10}$).

At an early stage in my investigations my attention was directed by as old a woodsman as Mr. R. B. Markle, of Westport, to the scarcity of redwood trees growing from seed. The point raised, my attention was constantly directed to obtaining a specimen which had unquestionably been produced by other than a growth directly secondary to, and demonstrably connected with an older growth. No pains was spared to investigate promising looking saplings, but never once was one found growing under what might be called normal conditions. Growths under abnormal circumstances were often instanced, and there can be no question but that the tree is capable of reproducing itself by seed. Forest-growths, like those described as types 1, 2, 4, and 5, can hardly have been produced in any other manner, beside the fact that there are points in the range where outlying patches of redwood trees (often several miles apart), now and then a few acres in extent, and again only in groups of a dozen trees, extend inland from the belt proper for considerable distances. These isolated patches—interesting developments in themselves—can hardly have sprung up otherwise than from seed.

Many persons assure me that seedlings are common, but when attempting to show them on the ground have always failed to do so. My own experience was that of Mr. A. H. Hooper, of Crescent City, who assures me that he has hunted the woods for several years with the express purpose of procuring seedlings and not succeeded in finding a solitary specimen.

The writer wishes here simply to note his own experience. Whether to be found or not, the seedlings certainly form but a very small percentage of the young growing trees, and the redwood—although possessing the ability to do so—certainly shows a marked disinclination to propagate itself otherwise than by a root growth.

The subject has no unimportant bearing upon the propagation of the tree, and may in itself explain the cause of the redwood being so narrowly confined to certain zones. This has always been attributed to the redwood's inability to flourish save within the limits of prevalent and heavy fogs, and its close restriction to a peculiar character of soil. (See F. B. Hough's excellent report on forestry to the Commissioner of Agriculture, 1878: "It grows only on underlying metamorphic sandstone, and does not thrive in other formations"). Neither of these statements tally with the writer's observations. The redwood may be found in flourishing state growing upon every soil, marine or volcanic, in the range. It grows on sandstone; it grows on talcose schists, and mica schists; it grows on granite, and, unless the writer is much deceived, he has seen one of the outlying patches of trees above referred to, standing upon a bed of serpentine, the redwood here growing among yellow pines and sugar pines; at least the country for miles around was serpentine, and no signs of a foreign formation suggested their presence. As to its close restriction to fog-swept belts, one of the finest developments which the redwood attains anywhere, that of the South Fork of Eel River, is in a district practically exempt from fogs. Heavy "dripping" fogs are unknown, or are of very rare occurrence, although river mists are common. A certain amount of atmospheric moisture is probably essential, and a very dry climate would probably be unsuitable to the redwood. The one striking peculiarity of the South Fork redwood is its development of exceptionally luxuriant foliage, which may, perhaps, be in consequence of an extra stock of leaves being required to fulfill the functions of the tree.

The writer believes the following facts go far towards proving that soil is of less moment to the tree than is generally believed, and that it in a great measure draws its nutriment from atmospheric sources. An excellent specimen has been noted growing upon rocky ledges, from the roots of which all soil had been stripped, only one far-reaching root still preserving any communication at all with the soil, its other roots hugging the bare rock and protruding out over the precipice.

Another curious instance noted was that of a fallen tree, of which a section had been sawed out, and the upper portions left completely removed from all connection with the roots. Here the branches, four in number, had righted themselves, and assuming an erect position developed into well-formed saplings, the largest fully twenty-five feet high and four inches in diameter.

No excuse is offered for presenting these facts in some detail. They may, if the writer be correct, suggest an adaptability of the tree to a wider range of conditions than the restricting influences above noted would imply. Much has been written upon the redwood, its habits, and peculiarities, and much misconception still prevails.

III.

TREES OF THE COAST RANGE OTHER THAN REDWOOD.

1. The Quantity of Standing Timber other than Redwood; the Present Resource; the Prospective Cut.
2. The Douglas Spruce.
3. The Yellow Pine.
4. The Sugar Pine.
5. The Cedars.
6. The Menzies Spruce.
7. The Firs.
8. The Oaks.
9. Miscellaneous Woods.

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Remarks.

o the redwood belt and its immediate vicinity. See map. 335,000,000 red in column 14, being inside of redwood belt.

a Mertensiana). [2]Not included in column 14, being in redwood belt and :corded in column 2.
n 14, for reasons above.

lumber for Trinity falls out high, not because timber is superior, but is for the home market, and the standard is low; but for this local con-19,000,000 would have been classed as unfit for sawing.

Remarks.

ler, and *Pinus Muricata*. [3] Estimate only applies to redwood belt and ›rds foreign timber besides redwood.
also, *P. Contorta* and white fir. § Average high on account of timber in estimate, but not standing on acreage recorded in column 2.
)0 cords, *Ceanothus*, *Pinus Tuberculata*, and scrub oak. Sundries: 270,-hinquapin, maple, ash, etc.
poplar, laurel, maple, and chinquapin. *P. Contorta*, *P. Tuberculata*, and

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THE QUANTITY OF STANDING TIMBER OTHER THAN REDWOOD; THE TOTAL PRESENT RESOURCE; THE PROSPECTIVE CUT.

Material existed for arriving at very fair conclusions as to the extent of the redwood resource, and the estimate submitted in this report is believed to be a fair approximation to the true quantities of standing timber. Redwood has now been a subject of practical study for thirty years and over, and much information has been stored. Professional experting has become an occupation in itself, and the actual performances of the mills can often be determined with fair accuracy. Operations have been conducted upon an extensive scale, the method of working, moreover, making a pretty clean sweep as it progresses; and sufficiently large tracts have been denuded to furnish data suitable for extended application, furnishing average figures, which tests of more limited scope would lack.

As regards other woods, matters stand far otherwise; experience fails and records are generally lacking. Here and there a figure of dubious accuracy may be found, but for the most part everything becomes more or less guesswork. Regarding the Douglas spruce, at least within the limits of the redwood belt, some fairly reliable information can be obtained; also, now and again, concerning the yields of tanbark oak a figure can be got at. Generally speaking, however, the records are very meager. Other woods than these just cited have little commercial value at present, and but little attention has ever been paid to them. They are simply regarded as so much useless material, pure incumbrances clogging the lumberman's progress. The redwood belt has also the great advantage over other forests, that within the limits covered by redwood, redwood growth greatly predominates, and is, above all, continuous: attention can be pretty well centered upon the essential elements.

In our other forests things become much more complicated. There is, first of all, some little difficulty in determining just what is timbered land and what is not, the gradations are so gradual between the heaviest growths and open ground merely studded with trees. The number of families, moreover, usually increases; their degree of representation constantly changes; their size and quality, and also the capacity of lumber yield for trees of apparently the same size but of different families, differs so much that estimates worthy of being termed anything more than guesses can only result from detailed examinations which are laborious and time-robbing operations. Long continued practice, even, is not always a guarantee of accuracy, as opportunity to test results is wanting. Estimating timber is and remains to a great extent guesswork. With the majority of "timber sharps," their performances are but guesses at first and remain guesses to the last. Careful work and close attention, of course, accomplish much in this line, as in all others, but much time and patience are required to hit anywhere near the mark.

These remarks are ventured, as perhaps not entirely out of place, while

submitting Table F, which is intended to be an "approximate estimate" of the amount of timber other than redwood in the counties which this report covers. They are not mere random figures, but are based upon numerous and constant attempts to cover the difficult ground they purport to cover. They are at least the outcome of much counting of the number of trees on estimated acreages, rough calculations of the yield of individual trees, noting of the percentages of trees of different families, and the relative number of acres covered by trees of the same kind, in different portions of the same counties. How far the observer has been correct in his observations, how far his application of data from known ground to districts not passed over has been a judicious one, he hopes future experience may throw some light upon; that others may find an interest in testing and making known the result of their observations. Care has been taken to leave the different items of the calculation open to easy inspection, criticism being earnestly courted. Only continued observation can hope to lead to correct results and guard against erroneous deductions which are worse than total ignorance.

The table presents its contents in the form of exact figures, reduced to feet and cords. This was considered the only suitable form of presenting the estimate, as original data—records of percentage and the like—would probably have conveyed little information to others than the preparer of the table. A specific disclaimer is here made of any desire to imply greater accuracy on account of the number of numeral places filled by figures other than cyphers, and which might just as well have been replaced by zeros; the figures are simply the results of the calculations by which they were determined, but slightly rounded off.

Whatever the deficiencies are, however, the "estimate" in a way covers ground upon which there is no other data, and, for lack of anything better, may within reasonable limits be considered correct. In a broad way, it probably covers the ground for which we intend to use it fairly well, and, used with some degree of caution, may not lead us very much astray.

The estimate contains two tables, respectively headed: "Fit for Saw Lumber" and "Cord Wood." As regards the use of these terms, some explanation is necessary:

Firstly—The estimate in nowise purports to cover *all* standing timber; young growths, say of twenty to twenty-five years and under, having been entirely disregarded, nor is it designed to cover "brush," ordinarily speaking. The words "brush woods," heading column 11, refer purely to matured growths of scrubby timber or the larger shrubs, such as are well adapted for fuel and are at present used as such, and that not merely by chance settlers, but such as really find a ready sale and have an established (if only a local) market.

Secondly—It should be stated that after passing out of the redwood belt timber of prime quality becomes exceedingly scarce. Numerous ailments affect the woods (some of which will be hereafter noticed). For local home consumption there is a sufficient supply, often of choice timber, now and again bodies extensive enough to possibly warrant the erection of mills of moderate size, where the timber is accessible. Generally speaking, however, if these belts are ever exploited for anything other than home consumption, it will only be at a time when our available supplies of choice lumber are so far exhausted that we must perforce utilize lumber which now would find no sale in the San Francisco market. The classification under the headings, "saw-lumber, for local purposes, at least," and "fit for cordwood," is simply an attempt to separate that which would be con-

sidered locally fit for sawing from that which is really not fit for lumber at all, and is by no means meant to imply its probable ultimate use for fuel, or even its fitness for such, when the wood is generically poor fuel wood. The criterion as to what was fit for saw-lumber, and what not, was simply present *local* practice, and consequently the standard of classification was a varying one. Of the final total quantity in Table A, more than one half is assigned to Trinity County, simply because the standard lumber of the Trinity County mills is low.* On the other hand, although much of our oak wood cut is suitable for use for better purposes, it is generally used for fuel, and it has all been classed as cordwood in consequence. Of the total 11,630,000,000 feet classed as saw-lumber, probably not one third would find sale in the markets of San Francisco, at least not as first or even second rate lumber.†

Let the restrictions regarding *quality* drop, accessibility presents itself next in order. How much of this 12,000,000,000 feet (say) could ever be got out of the country? Much of the best of it growing at altitudes of between 4,000 and 7,000 feet, shut up in the most broken mountain range of California, even could it be brought to the main streams, how get it successfully to their mouths? We call attention again to the topography of the range and the character of its rivers (see introduction). Rivers 150 to 200 miles to where they enter the sea, with average falls of 10 to 15 feet per mile; set with rapids; torrents in the rainy season, and fordable creeks in mid-Summer and Autumn. Let all restrictions fall: in mere point of quantity, how far will 12,000,000,000 feet of lumber go to supply a market whose present annual consumption, local and foreign, is between 400,000,000 and 450,000,000 feet?

We may utilize the data in Table F for another purpose. We may profitably compare the quantities estimated therein—regarding them as mere quantities of timber—with the resources in the redwood belt. Some modification of both quantities is necessary before they can be fairly compared.

Referring to Table A (see page 143), our redwood belt was estimated as capable of producing 30,478,870,000 feet of merchantable lumber or its equivalent; this with an efficiency of 28�4 per cent—that is, each one foot of lumber representing three and a half feet of wood standing in the tree.

This only refers to the sound lumber fit for cutting (not more than ordinarily affected with rot, nor liable to extraordinary wastage in falling), nor does it include the younger redwood timber, under say twenty inches diameter, usually used for "skids," etc., and not sent to the mills at all. Taking consideration of these two items, we may safely say that each foot of manufactured lumber represents an equivalent of four feet (instead of three and a half) in the standing forest, so that substituting for the redwood resource, in capacity to produce merchantable lumber its mere equivalent in wood, we have, for comparison with table F:

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*Yellow pine boards, with from one to a dozen knots, twisty in grain, and sure to curl and warp out of shape in the sun, find ready sale at good prices, as does also cedar lumber, which is riddled with rot.

† That the scarcity of good lumber for even local use is not exaggerated in the interior of the range, is proved by the fact that mills of only 2,000 to 3,000 feet daily capacity, and running from three to four months in the year, after a few years have to get their logs several miles away from the mills, not cutting off the timber by any means, but only culling out the small portions fit for use.

4×30,478,870,000, or 121,915,480,000 feet as the true standard of comparison.

Reducing the two quantities in Table F to one item, we have:

57,239,000 cords @ 1 cord – to 1,000 feet board measure	57,239,000,000
Saw lumber	11,630,000,000
Total	68,869,000,000

Besides the redwood there are other woods which can be as safely predicted as sure to be destroyed in course of time as the redwood itself, either being directly associated with the redwood and doomed to go with it, or else equally sure to go from other causes now in operation, not speculative and possible causes of removal. We refer only to the cutting of tanbark oak and the clearing of certain lands. These timber quantities then fall under the same head as the redwood, "doomed timber," and fall away from the quantity in Table F.

Not to refine *ad infinitum*, these items have been collected, and grouped by counties, are as follows:

Sonoma County, feet B. M.			491,000,000
Mendocino County			2,049,000,000
Humboldt County	Cleared for timber	3,335,000,000	4,685,000,000
	Clearing arable lands	1,350,000,000	
Del Norte County			752,000,000
Total			7,977,000,000

We have then,	
Timber Doomed—redwood	121,915,480,000
Plus as above stated	7,977,000,000
(A) Total	129,892,480,000
Table F—reduced to feet, board measure	68,869,000,000
Less, as above stated	7,977,000,000
(B) Balance	60,892,000,000

That is to say, granting Table F to be a true exhibit of the facts, the timber which, in the direct future, is sure to go on the immediate coast is more than double all the fair standing timber in the five counties put together, apart from that which will be cut, and leaving out of consideration all new growth.

Table A is based upon an average of from 35 to 48 cords of standing timber per acre, outside of the redwood belt (see column 15), which is our estimate, and is believed to be high enough, one acre taken with another. Admitted (for sake of argument), however, that our estimate is too small by half; that we should have gauged the standing averages twice as high (70 to 96 cords per acre, which would certainly be beyond the facts), still the standing timber of fair dimensions would not equal that destroyed by the time the redwood is cut out. Go still further, double this again, if desired. Place upon all the timbered acreage shown in column 2 of Table F, average yields of 150 to 200 cords per acre (which would be preposterous), and matters still remain unpromising.

The extent to which forests influence climate will never be so thoroughly determined as to warrant the prediction of the results of forest destruction with certainty. That an important influence does exist, however, few will now deny. Well wooded as the Coast Range at present is, the amount of its forest lands which promise to be divested of timber may well cause grounds for apprehension.

THE DOUGLAS SPRUCE.

(Pseudo-Tsuga [Abies] Douglasii).

[Locally known in the four coast counties as "red fir" and "yellow fir"; in Trinity County as "spruce."]

Second only to the redwood, in point of value and extent of its lumber product, is the Douglas spruce, its lumber, generally sold as "Oregon pine," being too well known to need more than passing notice. Suffice it to say that as a complementary wood to the redwood, it fills all the deficiencies which the latter may show, and, taken in conjunction with it, the two trees fill almost all the varied requirements of the building trade. Where the redwood is deficient it excels; and its shortcomings the redwood makes good. Without being by any means one of the hard woods, firmness of texture and great elasticity characterize the wood to a marked degree; and its peculiar capacity for furnishing long spars of straight-grained and sound timber (free from objectionable knots, at least,) renders it peculiarly valuable for many purposes of construction. For many uses in finishing work, flooring, and the like, it is highly adapted, provided the wood is properly sawed, so as only to present what is technically known as vertical grain; otherwise, being a stringy wood, with hard, flinty, pitchy winter-growths, somewhat loosely bound together by the softer summer-tissues, it splinters badly, and, under abrading influences, goes rapidly to pieces.

No tree presents so extensive a range of growth, and, as John Muir observes,* "it is not particular in its choice of soil—wet or dry, smooth or rocky, it makes out to live well upon them all." While among trees a perfect Bohemian, flourishing under the most varying conditions of climate and exposure, it is by no means always the same tree, and even in outward habit differs widely according to whether its lot falls in pleasant lines or hard ones. To commence, although botanically identical—or at

*In his delightfully written paper (The Coniferous Forests of the Sierra Nevada), published in the *Century*, Vol. XXII.

For a gracefully penned description of the tree we can not do better than to quote from Mr. Muir. Of the Douglas spruce in the Sierra Nevadas he writes:

This tree is the king of the spruces, as the sugar pine is king of pines. It is by far the most majestic *abies* I ever beheld in any forest. One of the largest and longest-lived of the giants that flourish throughout the main pine zone, often attaining a height of nearly two hundred feet, and a diameter of six or seven. Where the growth is not too close, the strong and spreading branches come more than half way down the trunk, and then are hung with innumerable slender swaying sprays, that are handsomely feathered with the short leaves which radiate at right angles all round them. This vigorous spruce is ever beautiful, welcoming the mountain winds and the snow as well as the mellow summer light, and maintaining its youthful freshness undiminished from century to century through a thousand storms.

It makes its finest appearance in the months of June or July. The rich, brown buds with which all its sprays are tipped, swell and break about this time, revealing the young leaves, which at first are bright yellow, making the tree appear as if covered with gay blossoms; while the pendulous bracted cones with their shell-like scales are a constant adornment.

The young trees are mostly gathered into beautiful family groups, each sapling exquisitely symmetrical. The primary branches are whorled regularly around the axis, generally in fives, while each is draped with long, feathery sprays, that descend in curves as free and as finely drawn as those of falling water.

No other tree seems so capable of adapting itself to earthquake taluses, and many of these rough bowlder slopes are occupied by it almost exclusively, especially in Yosemite gorges moistened by the spray of water falls.

least not distinguished from one another—two distinct varieties exist as regards color and general peculiarities of the wood, and the lumberman, in places where both varieties occur, never fails to distinguish the *red* from the *yellow fir*. Of the two varieties, although often growing side by side, it may generally be said, that the so called *yellow fir* affects the more immediate vicinity of the coast (say the outer fifty miles of the range), while the *red fir* predominates further inland. Whether the distinction can be carried further than a mere "lumber classification," is questionable, and even here the two varieties shade off more or less into one another. Experienced woodsmen claim to be able to distinguish the varieties by the appearance of the bark and the shape of the shaft, yet it is believed that, in many cases, only the axe determines the proper classification as red or yellow. It is certain, however, that the distinction is not a purely arbitrary one, at least as regards the wood, although it might not be altogether simple to define the differences sharply and to enumerate them concisely. Color is first of all a distinguishing feature. The one variety is light in shade, from its faintly colored sapwood to its darker shaded core, the tinge being decidedly yellow, often verging upon saffron. The red fir, on the contrary, after passing out of the well defined sapwood (which is seldom more than four inches thick); is distinctly reddish in hue, the tint suggested verging upon a light cherry, rather than any other red. The wood of the "yellow fir" (we preserve the terms for convenience of description, although the tree is not a fir at all), is mellower than the red fir, and—though according to its growth, the wood may be fine grained or coarse—it always shows a marked difference between its summer and winter tissues; whereas, the red fir (at least far inland), is so close grained as to present a uniformly hard surface, which polishes when dressed. The yellow variety, when properly handled, is often a finishing lumber, easily worked; * whereas, the *red* is essentially flinty, and little suited for carpenter work of the finer kinds. Long lengths of clear timber entirely free from knots are common in the yellow fir, while the red fir is apt to be full of pin knots, which, however, are firmly interwoven in the other fibers of the wood, and are not apt to fall out, being almost pure pitch wood and very compact in texture. Where the knots are only small, they may hardly be said to affect the serviceability of the wood.

If the writer has mastered a lesson in woodsman's lore, and correctly distinguishes the two varieties, he would describe the external characteristics as follows: The yellow fir shows coarse, thick bark, heavily water-furrowed, and the trees are generally heavier bodied and heavier limbed, besides showing more sweeping foliage than the red fir, which is apt to be very slender, with a trunk but little tapered and bark characteristically smooth. The bark of the yellow fir is seldom darker than a rich brown sepia, or when taking a purplish cast the hue is neutral tint; that of the red variety is almost black, and its foliage more pendulous and of a richer green tint than that of the yellow fir.†

While the Douglas spruce, as has been said, appears almost all over the Coast Range, wherever heavier tree growths are to be found, the character of the tree and the quality of its wood varies greatly, according to exposure. The great bulk of the valuable timber will be found among the redwoods, and immediately back of the belt. Here the trees protected

*Good shakes are often split from the yellow fir.

† As caution is advisable in treading ground not too well sounded, it is freely admitted that in this characterization points of distinction may have been taken as characteristic, which in reality were only casual and the result of local conditions.

from the direct sweep of the winds grow to fine size, clear of limb to considerable heights, and sturdy in trunk, and the tree is possibly the handsomest tree in the forest, fully bearing out Mr. Muir's description, save that here the foliage is more sweeping than strictly pendulous. While capable of withstanding wind and storm, the tree loses its noble proportions under exposure, the limbs then growing down so as almost to sweep the ground and the whole airy character of the tree disappearing. Altitudes up to five, and even six thousand feet, at least, seem to affect it but slightly. Some of its finest developments, say to trees eight feet and more in diameter and two hundred and fifty feet in height, may be observed high up in the Siskiyou Range. Yet, as the county becomes more openly timbered and the climate hotter, the tree hunts shelter more persistently, and in Trinity County becomes almost purely a cañon growth. Comparatively stunted and squatty on the exposed ridges, when found there at all (though always a large tree), under the lee of sheltering hills, it shoots up straight to a line, with shafts which taper but little as they become lost in the whorls of foliage, which often only first appear one hundred feet and more from the ground. On the south fork of the Trinity River the development becomes particularly imposing and beautiful. Here the foliage often droops and hangs in matted festoons about the trunk as nowhere else in the range, and the sprays have been observed ten and even fifteen feet in length, drooping perpendicularly from the limbs so gracefully pendulous as only to suggest comparison with a sheet of falling water. Here the name Pseudo-Tsuga first strikes one as being well chosen, and cursorily observed, the resemblance to the finest types of hemlock-spruce is for the moment misleading.

Exposure which tends to mar the external symmetry of the tree also impairs its value as a producer of fine timber. Wherever much exposed to winds, even where the trunk is fairly well sheltered, the tree becomes "wind shaken," and logs are apt to show much checking, which impairs the soundness of the wood. In addition to this, in the drier parts of the belt a species of white rot affects the Douglas spruce to a great extent, and its wood when so affected is valueless, being in woodsman's parlance "conkesy." Save for a looseness of the bark here and there, or a white spot showing itself occasionally on the trunk, nothing may indicate its diseased condition, and the tree may still appear flourishing and healthy.

In the lower counties of the redwood belt—Sonoma and Mendocino—the Douglas spruce is well represented, and its percentage to that of the redwood fairly well maintained at one third of the former, cañon, ridge, and hill slopes all taken into account. Further north the percentage of Douglas spruce diminishes, and in Humboldt County, within the lines clothed with redwood, hardly exceeds five per cent. For the rest, the extent of the resource, as nearly as determinable, may be as shown in Table F. Apart from the redwood, the Douglas spruce may be said to be the only extensively represented tree whose lumber is generally held in sufficiently high esteem by millmen to make it saved for market—the only tree which is not being destroyed without any return whatever. Even here the cutting of "Oregon pine" is regarded more as the utilization of a "waste product" than as a legitimate object of milling operations, and the profit in shipping it to San Francisco is said to be very small. Under these circumstances one can hardly speak of a regular output of "pine" lumber from our redwood mills, the product being merely incidental, and liable to fluctuation from year to year, more, probably, being cut when the price of Oregon pine is high than when this class of lumber is at a discount. It is from Oregon and Washington Territory that the main supply of "Oregon pine" is shipped to the San Francisco market. Our lumber statistics show

that for the year from October 10, 1884, to October 10, 1885, there were shipped by the mills on this coast:*

Shipped to San Francisco	175,858,011
Shipped coastwise	30,562,578
Shipped foreign	90,855,598
Total feet	297,276,187

although these figures do not apply exclusively to Douglas spruce, the so called "spruce" lumber (Menzies' spruce) being included in the above. The consumption of San Francisco and points directly drawing their supplies from this market may, therefore, be approximately stated at 175,000,000 feet, and as most of the lumber shipped coastwise probably was landed in California, the total present consumption of the State (especially taking that of localities supplied from local mills into consideration) can hardly be much short of 200,000,000 feet.

Of this amount—save as a general indication of what the total absorbtive capacity of our lumber markets is—there interests us more especially that portion cut by the mills in California.

The cut by local mills, operating simply to satisfy home demand, is small and fluctuating and the figures for any one year would hardly gauge this source of consumption. From the redwood mills there were shipped to San Francisco of pine lumber during the year 1885, 17,000,000 feet. This is the main item in the cut of "Oregon pine," although probably this figure might be reasonably increased to 25,000,000 feet, provided it were to cover all the wood of this kind produced annually in the district under consideration. A by no means insignificant item is that of split rails made from Douglas spruce, used in building fences. These being manufactured on the ground no count can be kept of them.

Unlike the redwood, the Douglas spruce is a tree rapidly on the increase. Young saplings may be counted by the thousand, and wherever fires do not prevail new growths make their appearance. Being a hardy tree, and, when growing in sheltered localities, a producer of good building timber—under all conditions of growth valuable as fuel—no tree in our forests promises to be of more permanent interest to our people. Needing little care, growing almost everywhere, being of fairly rapid growth, and always, among the coniferous trees, a good producer of shade, any work in the province of practical forestry can hardly dispense with the Douglas spruce.

As to the rapidity with which the tree grows, this probably greatly depends upon soil and other local conditions, as upon these elements the whole habitus of the tree depends. Being at times almost columnar, tapering but little when a sheltered growth and produced on good soil, and again, when much exposed, being strictly pyramidal, measurements made only upon sections of the tree can hardly correctly gauge its growth. We regret not being able to furnish fuller figures than the following, but append them as being records of fair average rates of growth, the trees upon which the measurements were made having been of regular proportions and generally well developed:

*As published by Mr. Thayer, Secretary of the Pine Lumberman's Association.

RECORD OF RING GROWTH.

Measurements on Douglas Spruce.

Diameter of Log.	Number of Rings.	Variety.	Remarks.
36 inches	93	Yellow fir	Locality: Headwaters of Burr Creek, on Overland Road between Blocksburg and Eureka, Humboldt County. The innermost 12 rings measured 3½ inches. Average width of innermost 12 rings, $\frac{7}{24}$ inches.
33½ inches	98	Yellow fir	On Norman's Ranch, on same road: the innermost 4 rings measured 1½ inches, or an average of ⅜ inches per ring. The outermost 16 rings measured 1 $\frac{2}{10}$ inches, or an average of $\frac{3}{40}$ inch per ring.

THE YELLOW PINE.

(*Pinus Ponderosa.*)

[*Locally known as "yellow pine," "pitch pine," and "bull pine," in the coast counties; one dark barked variety often termed "black pine," in Trinity County.*]

The yellow pine in the southern counties of the Coast Range is a purely inland growth, but constantly approaches nearer to the coast as one nears the dividing line between California and Oregon, until finally, about Smith's River, it joins immediately on the redwood belt. From the lines upon which it makes its appearance eastward, it continually gains in percentage of representation and soon becomes the preponderating species.

It loves warm, sunny exposures and grows freely on dry, red volcanic soils.

Its range of altitudes is less prescribed in the Coast Range than appears to be the case in the Sierra Nevadas, and to fix a lower limit of elevation would hardly be possible, as it may be found at Calpella, in the Russian River Valley, at an elevation of less than six hundred feet, and has been seen growing on the Smith River and its forks at altitudes but little above the sea level. Wherever the necessary warmth and proper degree of dryness of soil are found, it makes its appearance; on the other hand, the writer has seen it growing at its best development at an elevation of three thousand two hundred feet, and knows that it is to be found at higher altitudes, so that, though the yellow pine is not a tree which seeks high altitudes, he at least is unable to state the upper limit of its growth.

Throughout the range, fine specimens of the tree may be found, say from 3 feet in diameter up to 6 feet and more, and many specimens are from 150 to considerably over 200 feet in height, their clean cylindrical shafts free of limbs for from 40 to 70 feet above the ground. Yet the lords of creation are always rare, and the average yellow pine is hardly a lordly tree.

The great majority of the trees do not exceed 2 feet in diameter nor 100 feet in height, and these are the finer specimens of the younger growth, trees of even half the size being more common by far. With these the limbs grow low down, and the trunk has not as yet clothed itself with the smooth, regular external covering so attractive in the larger trees. The

bark adheres in felt-like matted streaks of uncertain shades, varying from reddish brown to black.

The yellow pine, characteristically an open growth tree, loves not dense shade, nor does its open and somewhat thin foliage cast heavy shadows. Usually studding the ground in open groves, it is seen at its best growing among other trees, which it usually outnumbers. Sunny mountain sides, of not too steep slope, it much frequents, and often taking almost complete possession of these, leaves the ridge summits to the sugar pine and cedar, the ravines to the Douglas spruce and firs.

While the above disposition is characteristic in the better timbered forests, though not rigidly maintained, the yellow pine often seeks a southern exposure, and whole districts will be found in which it replaces the other conifers almost completely. When this is the case, its own growth is apt to be but an indifferent one.

The yellow pine is in the interior by far the best represented conifer, and it promises to increase in mere numerical representation rapidly. In fact, what development the young saplings now growing by the million in closest proximity, since the cessation of systematic firing of the woods, will attain to is difficult to foresee.

Yellow pine has been always more or less extensively used in the interior for lumber, yet the product can hardly rank high in the scale of our woods. When trees are obtainable with straight grain the lumber may be less open to the objections urged against it than is generally the case. Yet under the best conditions little wood can be obtained which is free from knots, and the yellow pine will probably always be a rough lumber.

At least in the Coast Range, it shows a marked tendency towards twistiness of grain, and but little of it (the pin-knots also prevent it being such) is free splitting. It is a heavy and highly resinous wood, and generally the lumber, when exposed to the sun, warps badly; large timbers often twisting into inconceivable shapes, and boards are given to wrenching themselves loose from their fastenings, causing much trouble to keep them in place.

As with so many other trees, the lumberman seeks here also to draw lines of classification unrecognized by the botanist, and claims to distinguish by the outer appearance of the tree the legitimate from the bastard species. These, in Mendocino County at least, are respectively known as "pitch pine" and "bull pine,"* the term yellow pine being little used. The woodsman, basing his classification purely upon the wood yielded, and little hampered by botanical distinctions, regards these varieties as two distinct trees, and always speaks of them as such.

The yellow pine, on account of its immense representation, is surely destined in time—as other woods become more scarce—to furnish a large percentage of California's supply of lumber. Yet there are woods to-day in every way more suitable for furnishing fine lumber, which are being systematically exterminated without being put to any use whatever.

Of all the qualities of the yellow pine, the special facility with which it grows upon exposures little suited for other trees promises to recommend it to use in the future forestry of the State; yet, as a tree it neither presents a large amount of leaf surface nor does is produce the dense shade which many of our other trees so readily furnish.

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*This term the yellow pine shares with many of the other pines, it being generally resorted to to characterize any pine not of recognized value. Thus in various points of the belt we have *muricata, contorta, tuberculata, ponderosa, sabiniana,* and *monticola* (?), all locally known as "*bull pine.*"

THE SUGAR PINE.

(*Pinus Lambertiana.*)

In the Coast Range the sugar pine probably never attains quite the development which the finest specimens of the Sierras show, yet here, as in other parts, it stands acknowledgedly the sovereign among pines. Whatever the mammoth tree may be to the pleasure-seeking tourist, the sugar pine is the tree which, in the woodman's estimation, entitles it to first consideration;—a recognition the tree has attained at its cost. Wherever civilization has advanced the sugar pine has suffered, the finest trees having been cut to yield shakes for the settler's cabin, or to be put to any of the multifarious uses which farm improvement suggests.

Never a heavily represented tree, never forming forests by itself, it will be found—often only as isolated specimens—pretty generally scattered over the Coast Range. Even Sonoma County is said to exhibit specimens of sugar pine near the headwaters of Galloway Creek, while in Mendocino County the tree may be found in many localities. On Mt. Sanhedrim, and along the watershed between the Sacramento River and the waters which drain into Eel River, sugar pine is said to be common on the high ridges; and, if descriptions of the tree are to be relied on, the sugar pine here is often of good quality and fair size.*

The sugar pine, although a tree favoring rather higher altitudes, appears always more or less closely associated with the yellow pine, and is seldom found far separated from the latter. Thus, as the yellow pine approaches the coast the sugar pine follows it, and is found side by side with it, coming down to the flats of Smith River—therefore, near the northern limits of the State, growing at elevations but little higher than sea level.

It seems more choice in the selection of soil than the yellow pine, and seldom, if ever, grows save where snow falls. Flat ridge summits it much affects when the soil is good, and if not directly crowning the crest, steals just far enough under its lee to escape the full sweep of the wind, possibly also seeking the snows, which always accumulate more heavily just over the brow of the hill.

Sunlight it certainly seeks—the morning sun and the cross lights of sunset—but it seldom grows on parched lands, and frequents northern exposures rather than southern ones. The ravines it generally leaves to the Douglas spruce or the firs.

Only once does it cross the redwood belt; appearing (here unaccompanied by yellow pine) on the headwaters of one of the tributaries of the Matole River, almost within sound of the breakers.

Del Norte County presents one of the most interesting fields for the study of the sugar pine, the tree possibly showing peculiarities of growth not elsewhere to be seen.†

Some of the peculiarities here shown by the sugar pine are referred to in Appendix B. For the rest, the wood of the sugar pine is too universally known to need special notice here, and, of course, the wood in the Coast Range preserves all the general characteristics of that produced in the Sierra Nevadas. It may be said, however, that generally speaking much less clear length will be observed here than there, and that a more than usual

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* The few sugar pines seen by me in Mendocino County were but dwarfed representatives of the noble tree.

† Laurels may be in store for the botanist who first makes systematic study of these rugged hills.

percentage of sugar pines show a tendency to a spirally twisted grain, and that free splitting trees are rather the exception than the rule.

The sugar pine is a comparatively poorly represented tree, and its representation will certainly not exceed five per cent of that of the yellow pines. Among the young saplings the percentage of sugar pines is much less, even, and we may easily count one hundred young Ponderosa to one juvenile Lambertiana. Moreover, being a tree of comparatively slow growth, a couple of centuries must elapse before trees of any size can be produced. We have here only another instance of the fact that our noblest trees and most valuable woods are not increasing, while our forests are becoming stocked with inferior growths.

THE CEDARS.

1. The Port Orford Cedar.

(*Chamæcyparis Lawsoniana.*)

This choicest of our cedars appears in the extreme northern portion of the State, just where the redwood-cedar shows the last signs of extensive development. It belongs, more strictly speaking, to the trees of Oregon than to those of California, and was at least once extensively represented along the coast in Curry and Coos Counties, Oregon, but it has suffered greatly, it is said, from forest fires.*

There are evidences of this cedar having been formerly more widely distributed on our coast than at present, and it would appear that its place has been taken by redwood and probably more especially by spruce (*Abies Sitchensis*). On the flats immediateiy north of Crescent City and in the vicinity of Lake Earl, burnt cedar stumps are found among standing spruce, and are so common as to suggest the cedar having once been the predominant tree. However, as this *chamæcyparis* is a lover of low, rich, moist soils, and probably never climbs to any considerable altitudes, its development must always have been a restricted one.

Although still pretty generally scattered over the low bottom lands back of Crescent City, in isolated specimens and at times in groups of a dozen trees where the ground is swampy, it is only once in our State found collected as a forest. Along the north bank of Smith River, for a distance of about three miles above the town of Smith River Corners a considerable body may be found, extending back from the banks of the river about one half mile. The cedar on this tract has been estimated as capable of yielding about 2,000,000 feet of lumber.

The wood of the Port Orford, or Oregon cedar, is probably choicer than that of any other coniferous tree of California, not excepting the softest and best sugar pine. As the tree hardly develops branches at all, in the ordinary sense of the word, long drooping sprays of flat delicate foliage depending gracefully from the straight shaft—knots it has none, and the grain of the wood being straight and fine, almost to uniformity, a more beautiful working wood can hardly be conceived of. It is light creamy in tint, highly satiny in finish, takes a beautiful polish, and is wonderfully

* A fire which occurred about the year 1843, and which ran from Siyou Slough to Coos Bay is said to have frightfully ravaged this belt (of but limited area, at best).

fragrant. It is one of our few highly prized woods, and is especially valued for boat-building, and besides its other admirable qualities, shows powers of resisting rot, which only the redwood can rival.*

2. The Yellow Cedar.

(*Chamæcyparis Nutkaensis*? or, *Cupressus fragrans* (*Kelloggii*)?

The yellow cedar, or bastard cedar (as it is locally termed), differs but slightly from the white Port Orford cedar in external appearance, save that the foliage shows coarser leaves and a yellowish cast not common to the other, which is purely green—emerald green. Standing immediately with the Port Orford cedar, and closely allied to it, it has a wider range, and while the Lawson cedar is a purely local development, and, probably, does not appear back of the redwood belt at all (or very rarely), the yellow cedar may be found far inland, on flat moist ground on the banks of streams, and often appearing at not inconsiderable elevations where the slopes are level and the ground not too dry. Isolated specimens will be found all the way down the coast as far as Mad River, on some of the tributaries of which it is pretty well represented.

Its wood does not compare with that of the white cedar, and is characteristically rotten hearted. The common run of trees, seventy-five to eighty feet high, by two feet (sometimes three feet) in diameter, does not differ in size from the white; its bark is similar (much resembling that of the smoothest brightest barked redwoods, although often having a silvery tinge), though the yellow cedar often shows a channeled, even strongly fluted, trunk, which I have not observed in the white cedar.

The wood of this cedar, varying in color from faint boxwood yellow to dull cinnamon, splits freely, and it furnishes posts and shingles, but is held in small esteem among lumbermen, probably on account of the rareness of logs which are not pretty well eaten out at the heart. In fact, not unfrequently a few inches of sound wood is all that remains, the heart being completely gone.

3. The Incense Cedar.

Librocedrus decurrens.

This cedar is so generally well known that passing mention will here suffice.

The incense cedar makes its appearance with the yellow pine and sugar pine just back of the redwood belt in Del Norte County, and follows the general lines of the sugar pine south, through eastern Humboldt and Mendocino Counties, though like the sugar pine, it becomes less frequent and

*Of its peculiar durability under exposure, Mr. Henry Harvey, County Surveyor of Del Norte County, notes a curious case. A cedar log stood some years ago near Crescent City which measured eight feet four inches through. Over this a redwood had grown seven feet three inches thick, so that the cedar lay wedged in its trunk. The cedar, standing on a slightly elevated knoll, although on low ground, was still sound, save the sapwood, and furnished eight logs, which were split into shakes, and the redwood, according to Mr. Harvey's recollection, showed upwards of eleven hundred rings. (This indicates the fact that redwoods of slow growth may be found on low ground near the coast of Del Norte County as well as those of phenomenally rapid growth, as the one cited in Table E.)

The only opportunity for making measurements upon a white cedar was upon a stump, the core of which had been burnt out for a distance of 7¼ inches from the core; following this the next fifty years growth was recognizable, and measured just three inches, or for this period of the tree's growth $\frac{1}{17}$ inch per year. After that it was impossible to trace the grain, which, besides being very close, was badly charred. Even this imperfect measurement proves the tree to be of slow growth, as the log, which was three feet in diameter, could not have been less than three hundred years old.

less heavily developed the further south one goes, and increases in representation as one proceeds eastward into the heart of the range.* It is found especially well represented on the high ranges between the Eel and Mad and Trinity Rivers, but seldom grows to more than one hundred feet in height nor is heavier bodied than three (or rarely four) feet. All through Trinity County it is a common tree and, after the yellow pine, has developed more young saplings than any other tree.

Excellent as the wood is when sound, the tree is much subject to disease, being generally riddled by a fungus growth (a *dædalus).*† While this does not necessarily render the wood unfit for many purposes, it renders it valueless for lumber of the finer kinds. When sound it is as fine a wood in every particular as the redwood, the place of which it fills in the interior counties. It is a free splitting wood, and stands exposure to alternate dry and moist influence admirably, and is locally much used for making fence posts.

While generally a lover of high altitudes, associating freely with the sugar pine, it will at times descend on sunny exposures with the yellow pine, and seems capable of growing wherever the yellow pine grows. On the flats of Smith River it grows but slightly above the sea level, while on the other hand it seems to thrive up to the highest altitudes.

It is a cheery tree, and yields better wood and produces more shade than does the yellow pine, besides possessing much of the adaptability to varied exposure which that tree shows; for which reasons it will be found worthy of consideration in many places where it is desired to increase the growths of trees.

THE MENZIES SPRUCE.

(*Abies Sitchensis.*)

[*Locally known all along the coast of Humboldt and Del Norte Counties as "spruce."*]

This spruce is essentially a coast tree and a frequenter of bottom lands, although it is occasionally seen at considerable heights above the sea-level. When this is the case, the development is contrary to the general rule of trees that are about to give out, often an exceptionally fine one.

A dozen specimens of this spruce may be found at the mouth of Hare Creek in northern Mendocino County, after which sporadic appearance the tree is not found until it again appears above Cape Mendocino, at the mouth of Oil Creek, and then in all the gulches which open directly to the sea. The bottom lands at the mouth of Eel River are well clothed with it—or rather, were so—and from this point north, up to the State line, it fringes the redwood belt on its western skirt, an almost uninterrupted development, disappearing only where the soil is too poor to maintain it.

The tree, with its wide base and tapering (pyramidal) shaft, is well adapted to face the wind, and its growth is usually so dense as to successfully turn the storm. It is a handsome tree, with its clear, smooth-barked trunk, its dark, somber foliage, its numerous limbs, which fall in regular,

* Exceptionally the incense cedar invades the lines of the redwood belt, and is found, for instance, on the Boynton Prairie ridge back of Arcata.

† See Kellogg's Forest Trees of California, page 18.

parabolic curves on all sides of the shaft. This is often six feet through at the base, and the height, not seldom, is close upon one hundred and fifty feet.

Where sheltered from the winds, the limbs do not come down closer than to within thirty or forty feet of the ground. Yet, smooth as the trunk may appear, the branches formed in early youth remain as pin knots under the bark and sapwood, and the wood of the spruce, although soft and mellow, satiny in texture, and fine in grain, makes but knotty lumber; hence, its low estimation among lumbermen generally. For outside use it is not fitted on account of its proneness to rot, for it decays in a few years, when exposed to moisture. So the wood finds but limited application, and is relegated to the manufacture of boxes and similar small stuff—butter firkins and the like—or is made into "dunnage boards" for vessels, or put to other inferior uses, though in any but our glutted market it would command esteem.

Of all our trees, probably none shows less power to resist fire, and smoldering fires, even, are sufficient to scorch its thin bark and but poorly covered roots and kill the tree.

Wherever it appears with the redwood, it is of course radically exterminated when the land is logged, and unfortunately none of the mills, save only those at Crescent City, now make any attempt to utilize the wood. The attention of mill men is forced into other channels.

The Menzies spruce has an established reputation for seeking good soil and only growing upon such. Besides this, of all large trees, none can be cleared away with as little difficulty nor at as small cost.

A few brisk strokes of an axe girdles the tree; a small fire kindled around its trunk—a few minutes work in either case—kills it. A year later only a dismantled shaft remains, and this rots and blows over a year or two later. Finally nothing but the stump is left, and this is easily removed. The tree makes no effort in the meanwhile to reproduce itself. Once killed, nature may be left to complete the work; any subsequent labor expended is simply to accelerate destruction.

The Menzies spruce has yet a few years allotted to it, and then it will, in this State, belong to the things of the past.

The tree is a rapid grower, and when the conditions are favorable to its growth spreads rapidly. Of this we have proof in the so called "Deadenings" near Crescent City. They were bald as the palm of one's hand when the town was first built, but they are now forests of young spruce.

The Sitka spruce yields dense shade, and does not suffer by being thickly clustered. For this reason it might be a tree suitable for the forester's use; yet its adaptation to none but rich soils, and its probable restriction to low altitudes, would necessarily much limit its application.

As a wind-break it might do better service, and being a tree of striking appearance, and, though somber, of regular port and graceful habit, it may serve to good purpose in park gardening.

THE FIRS.

1. The Grand Silver Fir.
2. The Great White Silver Fir.
3. { a; The Magnificent Red Silver Fir.
   { b; The Noble Silver Fir.

1. THE GRAND SILVER FIR.

(*Abies* [*Picea*] *Grandis.*)

[*Locally known as white fir, or balsam fir.*]

This fir makes its first appearance on the coast a few miles below the Gualala River, and from here north, as far as the Eel River Valley, is a common tree, which often attains considerable size. It skirts the redwood on its westerly line, but is mainly found in the short gulches which open directly to the sea. After passing into the Humboldt redwoods, it becomes a well represented accessory tree, and remains such until the State line is reached. On the Eel and Van Dusen Rivers it skirts the redwood, and is common on the Mad River, where it forms bodies by itself at times, and, displacing the redwood, takes complete possession of many of the ridges. The most easterly point of its development was observed on Larabee Creek, not far from Blocksburg, where a few trees are found.

Of all the woods which are undervalued, and which are systematically allowed to go to waste, this is intrinsically one of the most valuable. Barring its proneness to rot away entirely in a year or two, when placed in contact with the ground, it is an excellent timber. For inside use, few woods surpass it. It is soft and white, works well, and holds a nail remarkably well—as is observed by Dr. Kellogg—who also notes in his "forest trees" (page 25), the peculiar variation shown in the rate of growth of this fir. It is believed that this difference in the rate of growth may explain the varied deportment of boards, made of this wood, under the action of wind and weather.

Near Eureka there stands a house which is covered with white fir boarding, and which, after twenty-eight years of exposure, is still sound, while I have also seen boards of rapid growth—nearly three eighths of an inch per year—which, after a few years' exposure, were worthless. The wide bands of summer fiber had been literally worn away under the action of the rain, leaving the narrow walls of winter growth projecting in unsightly ridges. Yet this refers to its use for outside purposes, for which it is not fitted. I have seen one sitting-room ceiled and wainscoted with white fir, and which had been oiled and lightly varnished, which produced as cheery an effect as could be desired. Used under water entirely, the white fir is said to last well, and Mr. Alexander Connick, of the Occidental Mill, at Eureka, informs me that he has seen white fir logs in dams sound and serviceable after redwood saplings had rotted out.

At present the white fir may be said to find no use whatever. It finds a limited application for "dunnage" boards for vessels, and Messrs. Hobbs, Wall & Co., of Crescent City, utilize the wood to some measure in making boxes, but even for this purpose a prejudice prevails against the wood, on

account of its pronounced odor. If I am right, however, this fir is utilized to make butter firkins of in the Eastern States, the wood probably being water-soaked before being used. At one time quite a trade existed in white fir barrels sent to the Sandwich Islands for packing sugar, but of late years the demand is supplied from the East. It is sufficient evidence of the good qualities of the fir, that so soon as one passes out of the districts where redwood is in use, the white fir becomes a highly esteemed wood.

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2. THE GREAT WHITE SILVER FIR.

(*Abies* [*Picea*] *Concolor.*)

This is the fir of Trinity County, and is found tolerably well distributed in all the better wooded portions of the county. For the finest specimens of the tree, one must look on the higher ridges only, where (as on the South Fork Mountain) it crowns the summit, coming in above the other growths. Here, fine trees, from one hundred and eighty to two hundred feet in height, with trunks four and five feet in diameter, are found. The bark of these trees, which is peculiarly heavy at the base of the trunk, is, save for its woody texture and lack of elasticity, quite similar in color and general appearance to cork. Almost equally fine growths extend in the cañon heads for some distance down the sheltered slopes. Along with the finer specimens, however, the tree is found in more stunted growth, as trees which do not exceed one hundred feet in height nor two feet in diameter, these trees showing a rough scaly, almost black bark, the color of which does not vary from that of the larger specimens. These smaller trees becoming ever more reduced in size as they descend to lower altitudes or are more exposed to heat, show themselves more or less all over Trinity. While, therefore, not strictly confined to ridge summits nor to cañon bottoms, these are the natural abodes of the fir.

The western slope of the shed between the Eel River and the headwaters of the Van Dusen is the most westerly observed limit of this fir, which first makes its appearance at an altitude of thirty-six hundred feet.

It extends east to the summit of the Trinity Mountains, and follows the range south into eastern Mendocino, while to the north it extends to the high divide which sends its waters northward to the Salmon River.

The wood of the fir is classed with the sugar pine as the best material in the county, and the *concolor* fir, among all its kindred, enjoys the distinction of not only furnishing good lumber for use under cover, but timber also which will endure for years the critical test of being used for sleepers, and which does not rot when half-bedded in soil.

3. (a.) THE MAGNIFICENT RED SILVER FIR.

(*Abies* [*Picea*] *Nobilis, variety Magnifica.*)

(b.) THE NOBLE SILVER FIR.

(*Abies* [*Picea*] *Nobilis.*)

[Often locally known as "Spruce," although by some properly termed "Silver Fir."]

These two firs, probably always growing together, belong to the trees of the high Siskiyou Range, and have not been observed at altitudes less than three thousand three hundred feet. They are also found east of the Klamath on the Salmon River Range. These firs come in above the sugar pine, and even the Douglas spruce, which here attains its most magnificent development, and rivals these noble trees in grandeur, cedes to them the loftiest sites. As far as my observation goes, the red silver fir is rather the larger tree of the two, and is the grandest tree in the Coast Range. Its straight, columnar shaft, often eight feet in diameter, rising over two hundred feet in height, is enveloped in uniform whorls of magnificent foliage, the tint of which, while distinctly silvery, is pronouncedly a smoke-blue, rather than a green. The massive trunks are of a rich cinnamon, almost Indian-red color; and the beauty of the tree is enhanced by the thousands of thickly-fuzzed silvery cones which crown the upper limbs. The nobilis rivals the red fir in size, but has a finer foliage, and the cast is silvery green, not silvery blue.

As to the value of these firs as wood producers, no reliable information was obtainable, save that they are not esteemed, on account of their alleged inclination to rot speedily when cut and left on the ground. Yet this objection is urged against so many of our woods which are known to be excellent when treated with care, that until tested and their deficiencies are proved, no case can be considered as made out against them.

Apart from any value which the firs may have on account of the woods they yield, they are trees of primary importance, both on account of their rapid growth, their range of distribution, and their predilection for ground upon which the snows lie deep in winter. The importance of trees of dense foliage growing high up among the heavy snows, cannot be overstated. They, and the Douglas spruce, are our greatest benefactors, and in this connection are to be valued far in advance of our more open foliaged pines. Just where our Spring sources need protection most, these trees make their abode, and close aggregation and dense shade are no deterring influences to their growth.

THE OAKS.

The oaks of the Upper Coast Range are:

1. **The Tanbark Oak, or Evergreen Chestnut Oak.**
2. **The Golden Leaf Cañon Live Oak.**
3. **The Pacific Post Oak.**
4. **The California Black Oak.**
5. **The California White Oak.**
6. **The Highland Live Oak.**

For a description of these oaks, their distinguishing features and much special information applying to their appearance in the Coast Range, attention is called to Dr. A. Kellogg's "Forest Trees of California" (see appendix to the second biennial report of the State Mineralogist). Time and space will only permit here of brief mention of the parts of the range where they are common, with a few notes on their economic value, and the uses to which they are at present devoted—when utilized at all.

1. THE TANBARK OAK.

(*Quercus densiflora.*)

[Often locally known as Spanish Oak.]

This oak is found well represented all through the redwood belt, at points where the redwood thins out and becomes scanty, consequently, in the lower redwood belt, it characterizes the summits and upper slopes of ridges, whereas, further north it forms a more or less continuous fringe, which skirts the belt all along its inner borders. The district around Shelter Cove from the Usal Creek to the Matole River shows an exceptional development of this oak. It may be found still moderately well represented for a considerable distance inside the redwood, appearing in patches a few acres in extent, for about fifty miles back of the coast. Even here it does not become entirely extinct, but becomes choicer in the selection of its sites, generally confining itself to more sheltered and shady localities, and, instead of seeking the warmer exposures, as it often does on the immediate coast, it skirts the streams and nestles in the gullies at the heads of water-courses, in the warm interior districts.

On the slopes of the Klamath, it is not uncommon, but becomes scarce upon the western flank of the interior backbone of the Coast Range, appearing again, however, after the divide is passed, but only as a scarce tree on the slope which drains into the Sacramento Valley.

It will be often found extending for miles, a tree or two here, a tree or two there, say one tree of fair size to the acre, but the heavier developments are generally confined to thickets of a few acres in extent. Again, the growth will become the predominating one, and the trees are then apt to be so thickly aggregated as to form a dense shade; but in this case the tree shoots up with slender, stalk-like trunks of but a few inches in size, and the foliage forms a dense mat overhead. Otherwise, where protected, but favored with sufficient warmth and sunlight, the tree assumes a strictly

arboreal habit, and is a very handsome, regularly shaped tree, much more symmetrical than any of the other oaks. On parched lands it often becomes a shrub, and covers the ground as dense brush, forming a covering at times not over a foot or so in height, or forming bushes breast high. On the whole, save the old and regular trees, which are rather exceptional, this oak shows greater inclination to degenerate into a bush than any of its cousins.

The chestnut oak is of great economic importance, and a well sustained demand for its bark exists. The wood furnishes one of the finest stove woods on the coast, and always fetches the highest price. It is a wood which splits freely, and shows a straight, somewhat coarse grain, the cell-ducts being clearly discernable. For an oak it is a soft wood, and, though saplings are tough, it is rather brittle than otherwise when matured, and is then prone to check. Left exposed to sun and rain, it rapidly falls to pieces from dry rot. It is not known what valuable qualities special treatment might develop, but it is probable that it would repay the labor of investigation.

Heavy bodied trees often show a bark-covering of almost two inches in thickness, and it is these old trees which furnish the best yields of bark. The slender bodied trees have but a thin covering, and are less profitable to the bark gatherer. The chestnut oak is a resource of considerable importance, and one which is being rapidly exhausted. There is always a market for the bark, and as rapidly as new roads develop a new section of the coast, the available bark is soon cut out.

There is probably no tree which has been so systematically wasted as this oak. As the bark is the portion of the tree for which the highest price is paid, this becomes available for market in advance of the wood. The common practice is therefore to cut down the trees and strip them, leaving the valuable wood to perish on the ground—this then becoming a serious source of danger from forest fires. As facilities for transportation extend, the shipping of bark extends also. Just so soon as living wages can be made at the business, the attack upon this tree commences. It is a poor man's resource, and like all property of the needy, is given freely for small immediate gain. An approximate estimate of the present resource, necessarily but a very rough one, will be found in Table F. The annual consumption appears to be about sixteen to twenty thousand cords of bark.*

As regards the yield of bark per acre, this of course varies immensely with the development, as also somewhat with the degree of care exercised in stripping the trees. Isolated acres are said to have produced as high as twenty-five cords. It is pretty good bark land, however, which will produce five cords per acre for a forty-acre tract located according to legal subdivisions. Mr. F. Helmke, at present of Blocksburg, has cleared a tract of two thousand acres, a third of which he considers to have been bark land, and which yielded fully six cords to the acre—four thousand cords for the whole tract.†

* Two of the best informed firms in San Francisco were applied to, to give an estimate of the consumption of bark. Messrs. Higgins & Collins believed that San Francisco consumed about twelve thousand and the Santa Cruz tanneries about four thousand cords of bark annually. Mr. Kullman, of the firm of Kullman & Salz, said the figures would not run below sixteen thousand cords for San Francisco, and about four thousand cords for Santa Cruz; say twenty thousand cords all told. No systematic record of consumption is kept. Thanks is expressed to both firms for their information.

† This is one of the best authenticated yields on record, both the acreage and the yield being accurately known. The figures apply to a part of the German Rancho in Sonoma County. The ranch was good bark land, and Mr. Helmke says it compared favorably with the tanbark country on the Usal, which is of the best.

The tanbark oak is a tree which probably might be successfully cultivated. I am informed that in Mendocino County sprouts from stumps, when kept properly trimmed, will in five or six years develop to trees twelve to eighteen feet in height and four to five inches thick. This is the experience of Mr. William Steven, of Low Gap. When trees are cut a wreath of sprouts usually springs from the stump. These remain stunted growths, if left uncared for, but when properly trimmed develop into trees. For artificially propagating this valuable tree the acorns would of course be available.

An apparent anomaly exists in the fact that quotations for tanbark cord wood always range higher for wood which is stripped of bark than cord wood with the bark adhering to it. The wood without bark is summer cut, while that with persisting bark is cut in winter. Why, in this case, the summer-cut wood should be prized above that cut when the sap is down is not clearly seen.

In reference to the stripping of tanbark, it may be observed that trees which have been scorched by fire do not strip readily.

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2. THE GOLDEN-LEAF CAÑON LIVE OAK.

(*Quercus Chrysolepis.*)

[Locally known as "Mall Oak," "Iron Oak," or also as "Florida Oak.]

This fine oak, in several sub-varieties, is found pretty generally scattered over the range, and is an oak which generally seeks warm, dry, sunny exposures. To attempt to define its habitat would be useless. It is more or less common everywhere, and the only place where it can be said not to grow is *among* the redwoods. Colossal oaks of this species are found, while again, like the tanbark oak, it covers whole acres as a dense brush-covering only a few inches high.

This is the only one of our trees which possesses immunity from wanton attack. Save for a definite purpose no one meddles with it, its local name, *iron oak*, being well merited. This is one of the best oaks we have, and saw logs may be easily obtained four, five, and even six feet in diameter. The wood is fine-grained and close knit, but it is not knarly, generally speaking. With the aid of wedges it can be split out into shapely pieces, and when not too old is springy enough to be used for axe handles. Its local use is especially for making malls, but its applicability to any purpose where hard wood is required is generally recognized, and it is used successfully for felloes and hubs of wheels and many other purposes, always sparingly, however, for its wood shapes itself to the wants of man only at the cost of labor and the sweat of his brow. The wood dresses well, and, save for its hardness, is free-working. For ship-knees it probably would be exceptionally serviceable, as Dr. Kellogg remarks. The "Forest Trees" refers to this tree as a close kinsman to the *quercus virens* of the Atlantic seaboard States, and rates it as an equally valuable wood; valuable enough therefore to be the object of especial governmental solicitude and protection.

3. THE PACIFIC POST OAK.

(*Quercus Garryana.*)

4. THE CALIFORNIA BLACK OAK.

(*Quercus Kelloggii or Quercus Sonomensis.*)

These two oaks—the one known everywhere as "black oak," the other as "white oak," and not generally distinguished from the California white oak proper (*i. e.*, *Q. lobata*)—are always so closely associated that the one seldom appears without the other. These may be called the typical oaks of the Coast Range.

Both appear as large and handsome trees, and both appear as dwarfed specimens, aggregated together by thousands; and growths of this kind, mixed with other shrubbery, often forms what is designated on the filed plats of surveys as *chemise* or *chaparral*. These are the extremes, and between the two, trees of any size and order of development are common.

Both trees furnish good wood. The post oak, as its name implies, is much used for fence building, and is straight grained and free splitting, and when not too old, supplies good and supple wood, which is used for many purposes. It makes good pick handles and wheelbarrow shafts, and will, if properly treated, make good wheel spokes. Both it and the black oak make good fuel, although the latter is rather preferred for this purpose. The black oak, when young, is very supple, and is somewhat used for making bands for barrels. The black oak especially is often a trim and shapely tree, and I especially remember one specimen, which, growing under the lee of a large yellow pine, had grown straight as the pine, which protected it, and had no branches lower than fifty feet from the ground, the diameter of the tree being over four feet at the base.

Both trees, if cut in the right time of year, ought to make excellent railroad ties.

The post oak and the black oak are the predominating oaks all through the zone between the redwood and the summit of the inner Coast Range divide.

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5. THE HIGHLAND LIVE OAK.

(*Quercus Weislizeni.*)

This oak is reputed to furnish good timber (see "Forest Trees of California," page 107.) I have not seen it anywhere, however, save on the slope to the Sacramento Valley, in Shasta County. It is reported to appear throughout the Coast Range, yet neither in Del Norte, Humboldt, nor Mendocino Counties have I observed it, nor in Trinity, save east of Weaverville, and here it is but rare. Even in western Shasta, at least as far east as the Sacramento River, it is a tree of only small size, hardly over thirty-five feet high, and a few inches in diameter.

6. THE CALIFORNIA WHITE OAK.

(*Quercus lobata.*)

[Often distinguished from the Post Oak as Mush Oak.]

This oak is a valley and bottom-land oak, and it is not extensively found, save on the Russian River, in Mendocino County, and north to the Humboldt line, on the valleys and rolling land, as also on the valley lands of Lake County, and predominates in the upper Sacramento Valley. This oak is heavy bodied, and forms large trees, but the wood is *brash*, and although it is used for fuel, the black oak and the post oak are preferred, whenever obtainable. Besides being a brittle wood, it is given to growing in irregular shapes, which, though they form picturesque trees and furnish fine shade, are too irregular and crooked-grained to furnish valuable wood. Of all the oaks named, this is the least valuable, and it is probably one of the oaks which have earned for California the reputation of having no good oak wood.

MISCELLANEOUS WOODS.

1. PINES.

A. Bishop's Pine. (*Pinus muricata.*)

[Locally known as "Bull Pine."]

Found on the coast outside of the redwood and extends north as far as Ten-Mile River, although as one ascends the coast it decreases in frequency and is replaced by tamarack. The Sonoma coast is its point of heaviest development. This tree is entirely unvalued, and wherever cut out to make clearings is burned on the ground. Some shipments of the wood have been made to brickyards in San Francisco, but as a fuel it is said to be of inferior value. Even this wood may be available for certain purposes, however, and Mr. Helmke informs me that while engaged in lumber manufacture at Fisk's Mills, he sawed two hundred thousand feet of bull pine lumber, which was used as plank for bridge covering, and that it stood the wear and tear excellently and was much liked. This is an instance of how, where there is a will to utilize things, a fit application can generally be found.

B. The Tamarack Pine (*Pinus contorta*).

[Locally known as Bull Pine, and not generally distinguished from *Pinus muricata;* if so distinguished, then often—as in the vicinity of Eureka—known as Squaw Pine.]

Appears on the coast near Point Arenas, and extends north, skirting the shore, in patches of a few acres to a few miles in extent, all the way to the Oregon line. Grows on sandy spits and sandy benches or sandy river-bottoms, but is seldom or never found where the bluffs rise abruptly to any height above the sea. The best development of tamarack is in the vicinity of Fort Bragg, where trees seventy-five to eighty feet in height, with straight trunks of small diameter (twelve to eighteen inches), are to be found. Generally, thirty to forty feet is a normal development. Along the coast the tamarack is much mixed with the bishop pine.

Aside from the coast development, tamarack is to be found in small patches (and then generally mixed with *Pinus tuberculata)* on high ridges in the Siskiyou Range and the bald hills north of the Klamath River. Here the tamarack is a very stunted growth, and seldom grows over twenty-five or thirty feet in height.

The tamarack has a poor record as a wood, besides its small size rendering it of little practical value.

Both the tamarack and bishop's pine are mainly valuable on account of their ability to grow on sandy coast lands, and to flourish under exposure to strong wind.

C. *The Knobby-cone Pine* (*Pinus tuberculata*).

[Also locally known as Bull Pine.]

To assign a habitat for this pine would be difficult. All over the upper counties—Humboldt, Del Norte, and Trinity—it will be found in localities, and always upon dry, parched soil and hot exposures.*

The tree is never very extensively developed, and is characteristically a small pine, twenty-five to thirty feet being its ordinary height. Clear Creek, Shasta County, presents a separate and comparatively speaking extensive development of *Pinus tuberculata*. Here the tree presents a somewhat different appearance from what it does on the watersheds which drain into the ocean. The tree here develops heavy branches for its size, and these divide, and the cones, instead of encircling the trunk only, form on the branches also. The cones are thicker and shorter than on the coast, and their color, instead of being straw-tinted, is brownish red.

A peculiar development of this pine will be found in the Siskiyou Range at high altitudes. Here, dark barked trees, from seventy-five to fully one hundred feet high, and as straight as an arrow, though of very small diameters—probably not to exceed a foot—with limbs and foliage developed only near their tops, are found. The trees I saw stood at an altitude of about three thousand six hundred feet. These trees are said to produce remarkable wood, which is of exceedingly fine texture, and the toughness of whalebone, both in the green and seasoned state. One instance was cited to me of a freight wagon having broken its axle, and a small pine having been utilized to replace it as a makeshift; the improvised axle doing such good service, however, that it was never removed. The wood, while fibrous and stringy, is said to work easily with tools, and take a beautiful finish.

D. *The Sabin Pine* (*Pinus sabiniana*).

[Generally termed "Digger Pine," "Nut Pine," or "Bull Pine."]

This pine is found in Mendocino County, near Potter's Valley, and in the vicinity of Cahto, but not heavily represented. All over Trinity County it is found—from the Trinity River and its forks clear through to Shasta and the banks of the Sacramento River. It affects warm sunny slopes, and together with the oaks, madroña, and, occasionally, yellow pine, forms the main tree-covering of parched southern exposures. The wood is considered excellent fuel, and it is reported to be highly serviceable for many purposes. These may be found extensively enumerated in the "Forest Trees of California," page 45.

* Heat is essential to its propagation, as its cones adhere to the trees for years, and open and shed their seed only in very hot weather, or after periods of drought. When fires run through the woods and the tree is consumed; this pine sheds its seed, and a year or so later young saplings cover the ground.

2. THE PACIFIC HEMLOCK-SPRUCE.

(*Tsuga Mertensiana.*)

The hemlock is found in the Mendocino belt of redwoods, often developed as fine specimens, but on the whole it is here a rare tree. One could probably hardly cross the belt at any point without encountering from twenty to fifty trees in doing so, but it forms no perceptible percentage of the forest.

Among the Humboldt redwoods it becomes more common, and increases in representation as one goes north, until near Crescent City it becomes a well represented tree. The redwood belt may, however, be designated as its abode.

It makes serviceable lumber for inside use, but rots as quickly as white fir when placed in contact with the ground. It is, however, on the whole, a less valuable wood than either the white fir or the Menzies spruce. It is subject to knots, which the first is not, and it lacks the softness and elasticity of the second. Like the two trees mentioned, it is seldom put to any use, but perishes unutilized when the redwood goes. Hobbs, Wall & Co., of Crescent City, use it for box stuff, but apart from this use it is a wood without a market, unless odd lots of the wood find a chance application for dunnage boards of vessels.

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3. THE NUTMEG TREE.

(*Torreya Californica.*)

This handsome tree is in the Coast Range merely an arboreal curiosity, and it is not found at all north of Mendocino County. A hundred or two hundred specimens would probably cover its total development in Mendocino and Sonoma Counties. If there were but more of it, it would be one of our choicest woods, being soft, and, practically speaking, without grain at all. It is so scarce, however, that no economic importance can be attached to it.

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4. THE PACIFIC YEW.

(*Taxus Brevifolia.*)

This tree is found all over the range, nestling away in the cañons, and always confined to the immediate banks of streams. It is never heavily represented, but at times may be found in thickets of twenty to thirty trees; generally speaking, however, it is scattered along the banks in isolated specimens. In the aggregate, the quantity is not insignificant, and. like the mountain mahogany every scrap of it should be valuable. It is straight grained, and, while green, is easily worked, but becomes very hard when seasoned. It is valuable for all turning purposes; makes good pulleys, friction-rollers, and excellent journal-boxes, where wooden boxes are applicable; is suited for a hundred different uses, among others making

the toughest of bows for archery purposes. Trees do not generally exceed a foot in thickness, nor grow much over twenty to thirty feet in height, although I have seen specimens over two feet in diameter, but in such cases the trees taper rapidly as they ascend. It is almost a desecration to enumerate among the purposes for which it is fitted that it makes excellent fence-posts; yet there is no doubt but that more of it has been used for this purpose than for any other. A better fence-post, however, could be hardly conceived of, as it never decays.

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5. THE MADROÑA.

(*Arbutus Menziesii.*)

The madroña is one of the most widely distributed trees in the whole Coast Range, and appears to be a tree which is increasing in degree of representation; at least there are districts where the increase in its numbers has been very perceptible. So, for instance, on the Klamath River, near Orleans Bar, where slopes which were formerly bare are now well covered with trees of this species. It associates itself naturally with the oaks, and grows generally where oaks grow, but has a wider range than any one of the oaks. As it is not shy of a hot sun, besides furnishing fine shade itself, it is a tree worthy of consideration wherever it may be desired to clothe slopes which face the south with groves of trees.

The wood of the madroña is generally only used as a fuel. It is, however, worthy of a higher rank among our woods than is at present assigned to it. The wood is of remarkable uniformity of texture, and very warm tinted in shade. It assumes a fine polish, and being of rather more than medium hardness, should find application to many purposes, where neither great elasticity nor great transverse strength is essential. If carelessly seasoned, boards of madroña are apt to crack at their ends, but this defect could be easily overcome. When cut with the sap running and left to lie on the ground, it naturally rots away in a few years, but if handled with care in seasoning, it ought to be a durable wood.

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6. THE LAUREL, ALDER, ASH, MAPLE, CHESTNUT, AND COTTONWOOD.

Of these trees, the first two, the laurel (*umbellularia Californica*) and the alder (*alnus rubra*), are the most extensively developed and the most important. Both furnish good woods, laurel especially; but its excellence depends entirely upon its mode of treatment and the time of the year in which it is cut. Against the laurel, a prejudice has risen up, on account of its supposed proneness to being riddled by worms, and the demand for this wood apparently has fallen off greatly of late years.* The laurel often

*Dr. Kellogg, in his "Forest Trees"—see pages 101 and 112—gives much interesting information on the subject of the woods of laurel and alder, not the least interesting his explanation of the fact that the attack upon the laurel wood by worms, is only a result of cutting the tree when the sap is up.

forms dense woods (as on the Eel River, near Rio Del). As it generally grows on choice land—always, when the development is such a heavy one—much fine laurel timber is going to waste, and its best developments will be cut away in a few years.

The alder, like the laurel, is not restricted to any portion of the range, but may be found all over it, the larger and finer specimens of alder being commoner, however, in the southern than in the northern counties, the largest trees being found in Sonoma and Mendocino Counties. Both trees find their best developments along river banks, but neither the one nor the other is confined to the immediate vicinity of streams.

The ash (*fraxinus Oregana*) is a tree pretty strictly confined to the banks of streams, and is found as two varieties (as distinguished by woodsmen), the "red ash" and the "white ash." Save that, if anything, the so called red ash has perhaps a somewhat smaller and finer leaf and a ruddier bark than the white, there is no external difference, and trees of the one kind grow side by side with those of the other. While the white ash is said to possess a brittle wood, that of the red is admitted to be of excellent quality. Whether these distinctions are warranted by facts or not is a question, as concerning woods to which little value is attached, much care is not taken by woodsmen to establish distinctions which are often arbitrary distinctions, after all.

The maple (*acer negundo*), like the ash, is found all over the Coast Range, and shows a preference for river banks, but often is found well up towards the heads of ravines, the maple showing the more catholic spirit in this respect. The maple often forms trees of large size, but the wood is at least locally not esteemed, and is considered a "brash" and brittle wood. Both the maple and the ash are too frequently met with to be ignored in an enumeration of the characteristic trees of the Coast Range, but are to be classed rather as rare trees than common ones.

Rather better represented than the preceding is the chestnut or chinquapin (*castanopsis chrysophilla*). This tree is found running in streaks, all over the range, at least from Willits in Mendocino County north. It often appears as a tree of very considerable size, heavy trunk and clear shaft, free of limbs forty and fifty feet from the ground; yet, like the tanbark oak, which tree the chinquapin much resembles, it is also found as a dense-growing shrub, not more than a foot high from the ground.

The chestnut is but another instance of woods which, when properly handled, are good and valuable, but which locally have but poor respect shown them.

The last of this group of trees, the cottonwood (*populus Fremontii*), is a very poorly represented tree, as it is pretty strictly confined to alluvial bottom land; therefore, while appearing almost everywhere where bottom land is to be found, it remains, from the nature of its development, but a rare tree. The wood is considered of little value, though Dr. Kellogg gives it a character differing from its popular reputation. Yet almost all of California's trees are rated at less than their deserts, and will remain so until trouble is taken to study their requirements, and care shown to bring out their valuable qualities by suitable methods of treatment, if it be nothing more than paying attention to cutting them when they are in a state rendering them fit for being cut.

IV.

CAUSES AND RESULTS OF FOREST DESTRUCTION.

1. Notes on the Agricultural Capacity of the Lands of the Coast Range; Probable Extent of Clearing of Forests.
2. Forest Fires.
3. Incipient Signs of Climatic Change.
4. The Effect of the Present Laws Upon our Forests.
5. Concluding Remarks and Recommendations.

THE PRODUCTIVE CAPACITY OF THE UNDEVELOPED LANDS OF THE COAST RANGE.

THE PROBABLE EXTENT TO WHICH TIMBER AND BRUSH LANDS WILL BE CLEARED, UNDER THE INFLUENCE OF AGRICULTURAL DEVELOPMENT.

In a country but sparsely settled, and the resources of which are as yet but little developed, the future of its timber lands can only be forecast by reference to the capacity of its soil for sustaining agricultural operations, or furnishing grasses fit for pasture. It may be safely assumed, that wherever the conditions are favorable for agriculture or grazing, or are liable to become such with moderate outlay, and the growing timber is not very dense, that bush and timber lands will be cleared, as soon as the augmenting price of arable land attains a figure which will pay for clearing. Correct conclusions will only be reached, however, when we judge, not by standards of average days-labor wages, but consider the persistent energy which men show in improving land which they intend making their homes upon; how, with this object in view, they will toil for years without weighing the value of the ultimate return, and eking out a bare subsistence, often hold on in spite of fate to homes which are untenable.

Had days' wages been the criterion by which improvements were deemed suitable or not, America would to-day be a wilderness.*

To go into the examination thoroughly, would lead into a subject as extensive as that which forms the basis of this report. What it is here proposed to do is to furnish a few notes upon the general capacity of some of the lands for supporting stock or for farming; to notice in the briefest manner some of the influences which are at work, tending toward improvement or deterioration. Upon these some other questions hinge, which are more or less directly connected with the subject of Forestry.

1. THE REDWOOD LANDS.

It has been stated under the heading "Reproductive Capacity of Redwood," that the redwood grew upon every formation in the Coast Range. To speak, therefore, of "redwood soil," is an incongruity; however, it is

*I was specially struck by one case which I saw in Shasta County, where, to create a garden patch in land which was phenomenally arid, a small, dry watercourse had been called into requisition. Here a patch of a quarter of an acre or more had been made to furnish good garden stuff, through continued building up of terraces of cobble-stones in the channel of the watercourse, thus forming a series of flat benches, upon which had been wheeled in barrows all the procurable soil for quite a distance round the channel. A side ditch was provided to lead the storm-waters around the garden, and a spring had been developed and lead upon the land. The industrious individual who had gone to all this labor to accomplish so small an end belonged neither to the Mongolian, or any of the almost equally frugal Latin races, but was pure Anglo-Saxon. At days' wages that garden must have represented a small fortune. Even in the redwoods, now and again, instances of heroic struggles against fate may be observed.

generally characteristic of land upon which the redwood grows luxuriantly that the soil is cold and "sour." Where redwoods have grown, it is currently reported that the pea does better as a corrective crop than any other growth, and of fruit trees the prune yields the best return, and does well on lands where redwoods grew. In some districts applé and cherry trees are said to bear well, but apricots and peaches do not succeed. As a general thing, the land is not productive to a high degree, although the rank growth of fern and shrubbery is naturally suggestive of fertility. The writer has ridden through fern growths which were so high that when seated on horseback he could barely reach their tops; growths, therefore, not less than eight feet high, which is high for our ferns. Upon immediately adjacent open land, in nowise differing from those on which the fern and redwood grew (both were bottom lands on Prairie Creek), oat crops were grown. This, the writer ascertained, produced, when made into hay, about one and one half tons to the acre, or, if thrashed, yielded not to exceed twenty-five bushels. This is a low yield, certainly, for sheltered bottom land approximately new. Where production is almost purely for home use, exact figures are not easily obtained, but the yield of one and one half to two tons of hay seems about the average yield derived from redwood clearings all over the belt.

Redwood lands, after being cleared, unless systematically seeded to grass and kept stocked with cattle, grow up in dense underbrush. Varying with locality, these growths differ greatly; but the most characteristic growths are of the Ceanothus family *(C. velutinis, C. lobianus, C. integerrimus, C. crassifolius, and C. divaricatus)*, hazel-brush, spirea, huckleberry, salmonberry, rhododendrons, azaleas, choke-cherry, raspberry, and blackberry bushes; in short, the varied shrubbery of the outer Coast Range. The growth often becomes so thick that the lands are, until cleared, totally unfit for grazing. Where the growth is not so dense, and is kept down by cattle being allowed to run on the same, as is much practiced on the lands immediately skirting the ocean, it seems that the browse, and what there is of grasses to nibble, will support one head of stock to from four to seven acres of land, varying somewhat with the locality and other conditions.

Where, as around Humboldt Bay and Crescent City, the lands cleared have been systematically seeded with grasses, the pasture is fairly good, though the only figure obtainable was where land was stocked with dairy cattle, and here about five acres was assigned to a cow. As to the grasses sown, mesquit grass was formerly in vogue, but now mixtures of several kinds of grasses are preferred—white and red clover, Australian rye grass, and orchard grass all being used.

It should, perhaps, be specially mentioned that by clearing, is simply meant removing the timber, and clearing the brush. The stumps always remain; the network of root filaments remain living permanently, it would seem, and this, if no other cause, would render ordinary redwood land difficult of cultivation; with each year, and after each plowing, a new crop of fine roots having to be overcome. To clear lands, stumps and all, would be an enormous expense, as single stumps often cost as high as seventy dollars to remove them.

2. BENCH-LANDS, FROM FERNDALE SOUTH.

On the elevated benches running south from Salt River to the Mattole, much good land exists suitable for raising crops of grain or fruit. Lands of good quality often fetch forty dollars per acre, and large tracts are being cleared of their brush and timber. The trees (mostly Douglas spruce and white fir and Sitka spruce) are girdled and the brush "slashed" and burnt. The cost of this operation seems to range between five and twelve dollars per acre. The lands being directly fitted for tillage and not pasture only, it is only a matter of time when all the available good land will be cleared of timber.

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3. SHEEP LANDS INSIDE THE REDWOOD BELT.

From the headwaters of Russian River to the Klamath River, and as far east as the south fork of the Trinity, the country is devoted to sheep raising, predominantly; the strip from Spruce Grove to the Mattole River being generally used for the same purpose. Much of the country was originally used for stock, but since the introduction of sheep, the original grasses—bunch grass *(festuca scabrella)* and wild clover and sunflower—have been eaten out, and now an inferior grass, said to have come from Australia *(gastridium Australe)*, and variously known as foxtail, squirreltail, May or June grass, has taken complete possession of the country, to its ruin. The number of sheep which lands are made to carry, varies from two head to five acres, to one sheep to the acre. Overstocking is common, and whereas the ranges when new pretty generally sustain a sheep to each acre, many of the older ranges do not carry more than the figure first stated. The foxtail grass, when the land is heavily stocked, becomes eaten out, as the sheep only nibble the head after the grass commences to ripen, and if heavily stocked a sufficiency of seed does not ripen and fall to propagate a new crop.

Instances have been cited where the grass-covering has been so far reduced that heavy rains have caused such serious wash of the soil that the land was not fitted for further use as a sheep range, even; had become, in fact, worthless.

The coast range formations are naturally subject to wash, and evidence of slides are noticeable on every hand. The overstocking with sheep is one of the worst influences in operation, and much land which would eventually come into requisition for tillage, is in this manner rapidly becoming worthless.

As ranges deterioate under the influence of overstocking, the remedy sought is to render new lands available through burning of brush and girdling of timber. Sheep lands are held at from five dollars up. As the value of land increases, the clearing of timber to render the land fit for grazing will increase, and considerable quantities of timber will be cleared off in this way.

Systematic attempts to improve the quality of sheep lands are not common, the writer knowing but one exception to the general rule. Here the best grass patches are fenced in and guarded, the grass allowed to ripen, when it is threshed and the seed collected. Brush lands (mostly scrub-

oaks), are then fired and the seed sown upon the ash-strewn clearings, the grass used being a species of Australian cheat. The lands thus artificially stocked with grass are said to possess twice the efficiency of the natural open lands.

In connection with the subject of sheep lands, it should be mentioned that the pernicious practices noticed in a great measure affect property still belonging to the Government. There are ranges covering thousands of acres which are controlled (not owned) by sheep men, their holdings simply covering the strategic points of the range, possession of the water sources generally sufficing in itself to attain the desired end. Holding these points, the balance of the range is of no value to any one else, and his herds range undisturbed over public lands. These lands are effectually excluded from settlement, the county and State governments deprived of legitimate sources of revenue, and at the same time valuable public property rapidly going to waste. The timber depredations upon public lands are but matters of minor moment compared with the gradual, but widespread ruin which is being brought about by sheep-ranging.

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4. THE RED-SOIL LANDS OF TRINITY COUNTY.

Trinity County has always found its main resource in mining. Stock raising has probably followed next in order, and agriculture has never been extensively enough practiced to supply the home market with cereals. There is, however, an abundance of good soil in the county, in every way suited for raising crops both of grain and fruit, or which is well adapted for pasture. Its development depends entirely upon a supply of water being rendered available at the proper time of year, and which, at present, is, generally speaking, lacking. The percentage of deeded land is small and the preponderately larger portion still belongs to the public domain.

The yield of agricultural land is low, owing to dryness of the soil at the period just before which crops mature, and it appears that at present the wheat land does not produce over ten to twelve bushels of grain, nor the pasture land more than one ton of hay to the acre, as average figures. Yet these same lands produce three and four crops of alfalfa and good crops of grain when irrigated. Alfalfa does generally well on this land, and if widely sown it might be relied on to produce one crop of hay annually without cultivation, which in itself would be enough to make it pasture land.

The foxtail grass, which has been spoken of in connection with the sheep lands which lie further west, has also spread over Trinity County, and probably one of the only means of eradicating this undesirable grass may prove the alfalfa, the value of which, if lands like those in question could be stocked with it, would be inestimable. Once started, its roots run down so deep in search of moisture that drought does not kill it, while sheep may range upon it without being able to eradicate it and spoil the range, as they do in the case of every other grass when the land is heavily stocked.

The future of these lands is hard to foresee. At present there is a general tendency towards a heavy growth of young trees, which have everywhere made their appearance since the Indian practice of running fires over the land has ceased. It is hardly probable, however, that under the

influence of an increasing population and a growing demand for land, any land will permanently be permitted to remain fallow which can be turned to profit if utilized.*

These lands, however, belong, for a great part, to the class which (in the introductory remarks on the subject of water supply) were considered as being capable of being rendered valuable by water, made available through forest cultivation of higher lying lands. It is, therefore, within the province of Forestry to greatly aid in developing these lands.

5. THE MOUNTAINOUS LANDS OF THE SISKIYOU AND SALMON RIVER RANGES, AND OF THE NEW RIVER AND TRINITY RANGES.

Under the four preceding headings we have considered, briefly, the general capacity for development of the lands of the Coast Range, north of the Russian River, which, in any probability, will ever be utilized for grazing or agriculture, and which are intrinsically valuable enough to make them centers of settlement.

The rest of the country consists of high barren rocky ridges, which, unless it be for the mineral wealth they may contain, will never be valuable—save a few ridges and plateaus, often several thousand acres in extent, which are said to be covered with waving bunch grass, and which will be valuable as ranges, provided the severity of the climate, or their general inaccessibility, does not permanently debar their use. In this division are to be embraced the Siskiyou Range (which lies north and west of Klamath River); the Salmon River Mountains (dividing the lower Klamath from the Scott River); the New River Range, and the "Trinity Summit" (which divides the main Trinity from the Salmon River), and the Trinity Mountain Range (which divides the waters of the Sacramento River from those flowing into the Eel River and Trinity River, and which forms part of the inner main divide of the Coast Range).

These are rugged complexes of rock and bowlders, barren and denuded dikes of stone, mostly of volcanic formations, predominately serpentine and granite. A more desolate storm-swept district can hardly be imagined, although rough as these mountains are, they are not divest of timber. Nestling in the cañons and on the sheltered slopes of ridges, especially near the river gorges, fine developments of timber will often be found, and save for the most wind-swept, storm-tossed stretches, stunted timber and brush-growths cover the ground, whenever the denuded rock admits of a growth of any kind.†

*It is, moreover, of great question whether the general growing up of this district in timber, such as is now growing on it, would serve any useful purpose at all. Under the head of "Forest Fires" one phase of the question is considered. As a locality for encouraging a new forest growth, hardly a district of equal area could be selected where a forest might be expected to exert less beneficial influence than here, on account of the peculiar topographical location of most of the land in question. Besides this, the prospect is very remote of this growth ever producing trees of large size, suitable for future reserves of timber. It is ground which, when the conditions have arrived under which it can be utilized, it will be by all means desirable that it be turned into pasture or be farmed.

†The efforts which certain growths will make to adapt themselves to straightened circumstances, finds an interesting exemplification in the brush growth of this district. The tanbark oak, the cañon live oak, the chinquapin, the madroña, all dwarf themselves to low shrubs, and form a matted covering, only a foot or two in height. Among these, dwarf specimens of tamarack and *Pinus tuberculata* appear, and even the sugar pine family developes a stunted variety, but a few feet high. (See Appendix B.)

This district, however, is of interest as containing the sources of the largest rivers in the State, and upon the snows which are here deposited in winter depend the summer flow of the Upper Sacramento, the Klamath, and that of all the large streams which flow directly or mediately to the ocean. These mountains and their timber growths play a leading part in the hydrography of the State. Any material increase or any material decrease in thè forests of this region is liable to be of far-reaching influence. It is, however, from the extreme inaccessibility of these mountains improbable that their timber will ever be cut to any considerable extent. If only properly protected from destruction by fire, they probably will never be seriously encroached upon.

An attempt has been made in the preceding notes to furnish some rough data from which might be drawn, in a general way, correct inferences as to the effect which agricultural development will have upon the country, and to what extent a further reduction of our forest areas may be anticipated from causes other than supplying lumber for market. In connection with our Table F, an estimate was made of what was the amount of wood which might be considered as liable to remain after the redwood had been cut. Certain deductions were at that time made for timber which was known to be in course if destruction, and which it could be predicted with certainty would go with the redwood. These items only referred to the land south of Ferndale, and only covered such timber as stood upon land which at present was known to be valuable enough to pay for clearing. No allowance, however, was made for causes of destruction which were considered remote enough to not admit of practical certainty, such as clearing of grazing lands which, although at present in operation, is not now practiced upon an extensive scale.

It is probable, however, that much of the open timber land will be cleared for farms and ranges in course of time.

FOREST FIRES.

While forest fires have ever been frequent in the Coast Range, and are of daily occurrence during the Summer and Autumn months, it is a matter for congratulation that one seldom meets with large districts whose timber has been totally swept out of existence by fire, as is the case in the forests of the range in Oregon.* To the ordinary causes arising from carelessness, there are added the constant use of fire in clearing land, and the practice of burning the debris of logs, bark, and limbs, caused in logging operations, and which it is claimed is an essential feature of redwood logging.

Redwood logs of size are of such enormous weight that special roads have to be constructed almost for every tree, and clear ground and free scope are essential requisites to successful work in the woods. Where timber stands very thick it is often necessary to work the same ground over twice, and often three times, before being entirely stripped. Each operation produces an enormous accumulation of refuse stuff, which has each time to be cleared away by burning before the logs are removed.

Much sound fallen timber intended for the mill, as a matter of course, is consumed along with the rubbish, though reasonable care is generally exercised to restrict the fires to the ground operated on. Through oversight, however, fires do get out, which often sweep over extensive areas before being checked or naturally dying out. This remark applies more especially to the southern portion of the belt, south of the Humboldt line.

In virgin forests the redwood generally escapes but little damaged; the tanbark oak and spruce, however, being for the most part destroyed.

It is generally conceded that the timber belt in Mendocino is completely swept over by fire about once in every five years—one portion one year, another the season following, but so that in the aggregate but little ground remains which, at the end of the period stated, has not been visited once at least by fire.

In the upper counties, Humboldt and Del Norte, fires, when started, are less prone to spread, owing probably to the moister conditions prevalent, although even here extensive fires have been known in periods of exceptional dryness.

Were the forest growth entirely composed of redwood, the damage might perhaps be confined to suppressing the growth of young trees, to which, however, too much weight should not attach, owing to the remarkable scarcity of small growing redwood trees, save under conditions which are more than exceptional; this peculiar scarcity of young trees among the sequoian forests appearing characteristic both of the redwood and its mammoth cousin.

Great stress has been laid upon the capability of the redwood tree, when sound and once it has attained a certain growth, to pass through ordinary fires undamaged, and attention has been often called to the desirability o redwood lands, as investments, on this score. This is entirely true; as even after sweeping conflagrations, the blackened shafts reclothe them

*For instance, the cedar belt of Port Orford, among which much damage has been done, as also the country between Corvallis and Yaquima Bay, which for a width of twenty miles, and, if I am rightly informed, a length of fifty miles along the coast, is to-day but a forest of burnt spars standing amongst underbrush.

selves with delicate foliage, and vitality continues unimpaired. Were it necessary, many interesting instances could be cited, from personal observation, of its power, even when half eaten through by fire, to make good the loss by local replacement of missing fiber.

These facts admitted, it nevertheless remains certain that the drier portions of the redwood belt are to-day seriously jeopardized by fires, and are annually becoming more so. Paradoxical as the statement may appear, the conviction is expressed that to-day, in portions of the belt in Mendocino County, more sound standing redwood timber is *in course* of destruction by fire than is being cut out by the mills. This being at variance with generally received views, a brief statement of the facts may be permitted.

In the lower belt, other trees, such as tanbark oak and Douglas spruce, are always largely represented, especially on the ridges and near their crests. At these points, moreover, the "tie cullers" have often been at work and much bark has been gathered, the wood of the oak generally remaining on the ground to rot, and the tie splitter—wasteful here as everywhere—utilizing only the best splitting timber; both operations tending to the creation of large quantities of rubbish. Upon hillsides as steep as these, this litter generally before long finds itself lodged against standing trees, and the next fires bring to bear directly upon the standing trunk a heat intense enough to start the process of *undermining* the tree. At first, confined perhaps to penetrating the bark and the wood fibers for a few inches, each succeeding fire, when an accumulation of litter happens to exist, continues the work of undermining, until finally a "doughty" (rotten) streak is struck, when the fire follows the seam and the tree is directly consumed, or until a point is reached when not enough of the section of the tree remains to enable it to withstand the storm winds of Winter, and it falls.

In this portion of the belt, the redwoods are especially firmly rooted, and I have failed to find the first tree turned over by the roots. Not so the other trees, all of which yield easily to heavy winds and are uprooted; their very existence being dependent upon the redwood, which fact can be easily proved by their going when the redwood goes, and that they are always trees of younger growth than the redwoods among which they stand.*

Steep slopes characterize the range, and as the trees disappear before the Winter tempests, their fall is generally guided by adjacent trees against whose trunks they naturally lodge, being ready then to extend the work of constant gradual destruction. The fallen oaks season rapidly, and their wood (our choicest fuel) burns with intense heat; the Douglas spruce, rich in pitch, catches fire easily and burns fiercely, and the fallen redwood, always more or less cracked in falling, and moreover, on these ridges generally showing "doughty" streaks, burns more readily than elsewhere, natural chimneys being created through which fire is rapidly sucked by the draft. If the fallen tree is not consumed by one fire, the consequence is only aggravated, as until finally consumed, it continues with each succeeding fire always to operate upon the same point of the tree, against which it chances to rest.

The process has been sufficiently indicated, and it only remains to point

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*As regards subsequent growths, when the fine timber is gone, the redwoods are not replaced, young spruce only appear sparsely, and as to the reproduction of the tanbark oak, shoots sprout willingly when the roots are left in the ground, but when not cared for do not develop into trees but form a mere brush. The aftergrowth generally may be characterized as brush, raspberry, hazel, huckleberry, and bushes of the ceanothus family rapidly covering the ground and forming dense thickets. This growth is of little value, but is an excellent agent for transmitting flames.

out one other feature. It is generally held that a ridge summit is a natural barrier to fire, which is passed with difficulty, as fires, as the statement runs, "*do not run down hill.*" While this is certainly true as regards forests of standing trees, it ceases to be true of forests in the condition described. During fires, the burning logs are freed from their chance supports and rolling down hill will transmit fires rapidly, which otherwise would not spread, to which fact credible eye-witnesses bear testimony, stating how quickly a fire will cross a ravine and appear on the adjacent ridge, especially where winds facilitate its progress.*

The gradual work of forest destruction, now so little marked as not even to attract general recognition, always has its origin on the higher ground. With each succeeding year the danger will be augmented, and even gullies and cañon bottoms, naturally little visited by fire, may not always remain exempt from ravage.

These remarks apply to the Mendocino belt. After crossing the Humboldt line, moister conditions generally prevail; fires do not spread easily, and foreign timbers are more rare among the redwoods, besides the country being generally smoother and less broken into ridges. Only in the event of continued removal of timber, in course of time creating drier conditions, is a similar danger to this belt from forest fires to be anticipated.

The accumulation of dead wood and debris being the chief agent of destruction, and redwood logging being conducted as a work of extermination, and not likely to be conducted upon other systems, it is believed that the use of fire in the woods in logging, as a means of removing litter and fallen wood, is on the whole beneficial rather than otherwise, and should not be discountenanced in itself; especially when, as now extensively practiced around Humboldt Bay and Crescent City, the clearing by fire is but a preliminary step towards seeding down the cleared ground with grass.†

It has been conceded that fire may be a useful agent, but as it has been pointed out that real danger threatens from its careless use, due precaution should be exacted in the interest of the public good to guard against its misuse. Self-interest generally suffices to insure reasonable care, but fires do get out which, beyond question, if proper inquiry were made, could be traced to pure carelessness. Restrictive legislation, unless supported by proper supervision, is at best an unwieldy tool, and generally useless for lack of enforcement. If, in conjunction with a system of practical forestry, some competent official were at hand duly authorized, firstly, *to aid in checking fires when running*, and afterwards compelled to trace its source and cause, and if resulting from avoidable causes to fasten the responsibility where it belonged, much evil might be avoided. The moral influence exerted by the mere existence of some person upon whom it were incumbent to make proper inquiry, would in itself go far towards making the carelessly disposed more careful, and obviate many fires.

Total prohibition, under legal statute, of all use of fire, in the writer's humble opinion, is unsalutary. In the northern counties, wherever self

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*I have seen ridges several miles in extent where fifty per cent of the standing redwood trees were more or less seriously damaged by fire. The road from Cahto to Westport is a fair instance of this. During the heavy storms of January, 1886, some fifty redwoods were blown across the road from Mendocino City to Ukiah, and between twenty and thirty trees blocked the short stretch between the Low Gap and the Summit (all on about one mile and a half of road).

† It is to be only hoped that this practice may prove capable of wider application, and yield sufficient returns to keep the converted timber lands in a state of practical efficiency. This will probably only prove the case provided the clearings are kept well planted in grass, and sufficiently stocked to prevent the growth of underbrush, which otherwise a year or two is sure to bring forth.

interest suggests the aid of fire—fires have seldom failed to make their accidental appearance even if the law were not flagrantly disregarded. In the Fall months of the year the whole country is hazy with smoke, and the fires are in nowise restricted to private lands. Illicit practices are always the hardest to guard against, especially where partially countenanced by local public sentiment.

It must be remembered that reference is solely made to a heavily timbered district, the natural and proper development of whose resources necessarily implies the destruction of much of its timbered areas; where the climatic conditions are such that much of its timber may be dispensed with without evil consequences following; where the legitimate province of forestry can only extend;—firstly, to perpetuating a supply of valuable timber, adequate to the prospective consumption of the State, with as much margin for outside demand as circumstances will admit of. Secondly, to such corrective measures as may increase the efficiency of certain limited portions of the range, with a view to promote better conditions as regards the distribution of the flowing waters, and aiming to create a supply of water (at present lacking, notwithstanding the immense and excessive annual aqueous deposits), available at high elevations, during short dry periods of the year; the necessity of which will be unquestionably felt when farming of the high lying lands comes into practice. And perhaps, thirdly, to keeping clothed with timber, exposures, which if stripped, might suffer serious denudation.

These three points covered—especially if fairly compensating at higher altitudes for the timber cut in the immediate coast belts (now generally in private hands and beyond State control)—would, it is believed, prevent the probable evil consequences which total extermination of the lower forests can hardly fail to produce, unless remedial measures go hand in hand with the destruction.

Should these suggestions prove, after thorough examination of the whole field, to be well founded, the mere fostering of young growths need only be a matter of solicitude where dense growths are desirable, or where new growths are sought to be established.

As regards the growth of young timber—save only among the heavy redwood forests—the number of young trees which within the last decade or two has sprung up is very great. All the open pine forests, back of the coast, are becoming rapidly stocked with young trees, and much of the open grazing land is rapidly being converted into brush or becoming covered with young saplings—generally Douglas spruce or yellow pine.

The cause of this increase is unquestionably the cessation of the old Indian practice (formerly general) of running fires through the country to keep it open to facilitate hunting, or in driving game before the flames into inclosures set with snares. Under this system about half the ground was burned over each year, in alternate halves; thereby the open lands were kept free of brush and all growth of young trees was checked in the forests. The older, well matured trees, however, suffered very little, as so little undergrowth could mature between one fire and another, that sufficient heat was not developed to hurt older trees, fairly covered with bark and with limbs some distance above the ground. In fact, the Indian system became in some sense a method of forest preservation, and to it we undoubtedly owe the noble forests which were transmitted to our hands.

We may acknowledge this debt to the red man, although his methods may no longer be available in a growing country studded if only sparsely with improvements. The Indian's method may not have been an ideal

one, but it was a better one in his day and generation than our lack of all method is in ours.

The very growth of young trees, left uncared for as at present, must be to those with the good of the forest at heart, a source of concern rather than of satisfaction. With forest fires running—often twenty in a county at one time—and public sentiment dormant to the extent that, save where individual property is at stake, few take the trouble to put out even such incipient fires as might be killed with little effort, there can be no question but that in the growth of young trees *lies the certain guarantee of total extermination* of much of our best forest land, within a few years, unless some effectual methods of protection are inaugurated.

Thirty years ago fires ran yearly through the woods, but forest conflagrations were unknown; the large trees standing sparsely scattered, say five to ten to the acre, were unable to transmit fire, and there was little on the ground to burn. Now thousands of young trees fill the open spaces, and a fire started not only destroys the young trees but the patriarchs of the forest also.

As yet the evil has attained no very serious proportions; but so surely as the young growth is permitted and fires *not kept out entirely* (which will be found a simply impossible matter) fires will occur, which will sweep everything in their path out of existence.

The longer the matter is left to find its own solution the more difficult and expensive of application remedial measures will become.

As a means of protection against fires, one effectual method, and only one, suggests itself—the isolation of such forests as it may be deemed essential to preserve, into blocks of moderate area, separated by strips of waste land, wide enough to insure no spread of fire from one belt to another. This done, the forests may be left to grow up densely, if desired, without fear of extensive damage.

Topographical conditions would generally suggest the location of these waste strips. Ridge summits and cañon bottoms (especially the former) are natural barriers to fire, being only crossed with difficulty by flames, when free of brush and litter. The lines of watershed on spurs are generally sparsely timbered, and could be easily maintained free of undergrowth, even if not denuded of their trees. As regards the strips which have been designated as waste, they might in many cases be capable of sodding or being maintained in grass, producing range and pasture, and for the rest, the authorized use of fire by duly commissioned persons, duly provided with adequate means of checking the spread of flames, might suggest itself as the simplest, cheapest, and most efficient method.

Of course these proposals only have reference to the public lands, private holdings must remain subject to private management, and such forests as now are held in private hands must survive or perish, as the owner elects. In any event, private holdings, when lying within the lines of districts which it might be wished to treat on the basis proposed, will always cause complication. If anything is to be done at all, it is time to do it now, while the Government owns whole districts free from settlers, and consequently, in this respect, at least, need have nothing but the public interest to consider.

A STUDY OF THE INCIPIENT CLIMATIC CHANGE NOTABLE IN HUMBOLDT COUNTY.

THE INFLUENCE OF REDWOOD FORESTS UPON THE FLOW OF STREAMS.

At no point in the Coast Range are so many influences at work stripping wooded lands of their covering as in the vicinity of Humboldt Bay. A perfect cordon of mills extends from Rohnerville, on the Eel River, around the shores of Humboldt Bay to Arcata and up the Mad River to its north fork.

The bottom lands of Eel and Mad Rivers were formerly well timbered with spruce, and heavy growths of underbrush covered them. These have been cleared, as also much agricultural bench-land about Eureka and Ferndale, and much of the logged redwood land converted into pasture. Nowhere has so much energy been focused upon a district contained within equally narrow lines. The acreage cleared in one way and another cannot fall short of about fifty-six thousand acres; or rather, the area within which these operations have been centered, and which was predominantly brush and timber land, will about reach this figure. Compared with the area embraced within the redwood belt, this is but a small acreage, yet signs exist that climatic changes are in progress which may well stand in connection with the clearing of land referred to. That some local influence might have been noticeable would hardly attract wonder, but that the influence should be far-reaching and discernable inside the redwood belt is a matter which would have been received with skepticism were the evidence not unquestionable, the sources from which the statements were volunteered various, and coming from persons residing far enough apart to warrant the observations being general, and not due to chance influences with only a local significance. That the alleged changes have up to the present proved rather salutary than otherwise in nowise affects the case, it being unreasonable to assume that if changes are in progress their march will be an interrupted one.

The facts are stated in the order in which they came to me.

My attention was first directed to a possible climatic change, by the statement of Mr. H. P. Scott, of Orleans Bar (on the Klamath River), to the effect that the seasons were becoming milder, less snow falling in winter, and the frosts having been less severe for a period of several years; as also, that hot days in summer were less numerous, and that cloudy skies had become frequent, whereas they had formerly been uncommon.

This statement was corroborated by Mr. John Lord, who for twenty-seven years past has resided at Arcata and Orleans Bar, dwelling in one place and conducting business in the other. He adduced additional facts, and traced the influence as far as Arcata. Fogs, he asserted, now come down to the Klamath, as far up its course as the mouth of Bluff Creek,* which up to within a few years past had been unknown; besides which, the snowfall upon the Elk Prairie Ridge, between Redwood Creek and the head of Little River and the north fork of Mad River, had for several years past been so much reduced that pack trains now take this divide in winter,

*Township 10 N., Range 5 E.; Humboldt base and meridian.

although previous to that time a lower trail had been traveled and the ridge only used in summer. Mr. Lord also called my attention to the fact of the decrease of summer fogs at Arcata, which he said were so much reduced in frequency and denseness that for a year or two past crops of potatoes had failed for lack of moisture in the summer months.

The marked decrease of fogs on Humboldt Bay was attested to by numerous persons; and Mr. Comstock (of Flannigan & Brossman's mill) cited the fact that several streams heading in the bench land back of Eureka now carry not one fourth as much water as they did in 1854, when he first arrived. And not only in summer had he noted the decreased flow, but in winter as well.

Years ago, I was informed, navigation on Humboldt Bay was greatly impeded by fogs, which were often so thick that objects were not discernible a ship's-length from the observer, whereas they are now seldom thick enough to cause serious inconvenience to vessels; and that whereas the average fog now lifts by about ten o'clock in the morning, in the days of early settlement the sun seldom made its appearance until well after noon.

Ferndale is still a foggy locality; but many persons have attested to the decrease in the frequency of the heavy dripping fogs, which formerly were almost of daily occurrence, and which wet the ground like heavy rain.

This chain of evidence has been followed through a district, the extreme limits of which are almost seventy miles apart; and to the writer the testimony is convincing. Orleans Bar is thirty miles back from the coast, and thirty-six miles from the nearest point where clearing has been carried on, and is separated from the Mad River by two main divides, which are, respectively, 2,725 and 2,990 feet in height. Verbal testimony, unsupported by instrumental observation, is, however, open to criticism. We have, however, tables of rainfall, reaching back as far as the year 1859–1860, which bear out the statements entirely, and go to show that at Fort Gaston (Hoopa Valley), back of the redwood belt, the rainfall has *constantly increased*, whereas at Humboldt it has *decreased*, and warrant the inference that as timbered lands are cleared the coast climate is liable to become drier, while inland districts *may* derive, in increased rainfall, the benefit of the decrease on the coast. The tables of rainfall are taken from the State Engineer's valuable collection of "Statistical Tables;" and the sources from which these tables were derived are official, being the meteorological records of the War Department and the Lighthouse Board. It is to be only too much regretted that only tables of rainfall are at hand, and not records of temperature and humidity as well, so that the influence on these important points might be traced also.

TABLE G.

Showing the Average Annual Rainfall at Fort Gaston and at Humboldt Bay.

Fort Gaston. Authority: U. S. War Department.		Humboldt Bay.			
		Fort Humboldt. Authority: U. S. War Department.		Humboldt Lighthouse. Authority: U. S. Lighthouse Board.	
Period.	Average Rainfall. Inches.	Period.	Average Rainfall. Inches.	Period.	Average Rainfall. Inches.
1861-62 to 1871-72	45.77	1859-60 to 1862-63	34.95		
1872-73 to 1878-79	47.12	1863-64 to 1865-66	32.05		
1879-80 to 1883-84	52.79			1875-76 to 1877-78	35.49
				1878-79 to 1880-81	31.19
				1881-82 to 1883-84	30.76

NOTE.—The data from which these figures were compiled will be found in State Engineer Hall's Report for 1886, "Physical Data and Statistics." For Fort Gaston, see pages 46-47, and for Humboldt Bay, see page 185.

The record for Fort Humboldt covers only the years from 1859-60 to 1865-66; that for the Humboldt Lighthouse, the years from 1875-76 to 1883-84. The two points lie so close together, however, and the elevation of the gauges is so nearly the same—50 feet and 53 feet—that the records, although referring to points a few miles apart, may for all practical purposes be considered one record, whereby it is to be observed that the rainfall at the lighthouse would naturally be somewhat greater than that at Fort Humboldt, as the former is, of the two points, the one nearer the ocean.

Referring to the Humboldt Lighthouse record again, the only unmodified records in Mr. Hall's tables are for the following years:

1875-1876 .... Rainfall 48.76.
1879-1880 .... Rainfall 36.96.
1880-1881 .... Rainfall 30.80.
1881-1882 .... Rainfall 39.98.
1883-1884 .... Rainfall 24.77.

With one exception—that of 1881-1882—they show a constant decrease in the rainfall.

The rain records of Mendocino County, as shown below in Table H, differ from those of Humboldt inasmuch as, comparing the rainfall of the coast with that of the interior, the coast rainfall shows diminution without corresponding increase at Ukiah.

TABLE H.

Table of Average Annual Rainfall at Ukiah and that on the Coast.

Ukiah. Authority: Geo. McCowan.		Coast Rainfall.			
		Point Arenas. Authority: U. S. Lighthouse Board.		Mendocino. Authority: C. W. Denslow.	
Period.	Average Rainfall.	Period.	Average Rainfall.	Period.	Average Rainfall.
1876-77 to 1877-78	38.77	1875-76 to 1877-78	41.37	1871-72 to 1875-76	53.38
1878-79 to 1880-81	36.19	1878-79 to 1880-81	28.02	1876-77 to 1879-80	61.52
1881-82 to 1883-84	24.69	1881-82 to 1883-84	22.08	1880-81 to 1883-84	37.75

(See page 188—"Physical Data and Statistics.")

These figures are both interesting and suggestive. If a change is noticeable at present, the question suggests itself, what may not be the extent of the influence by the time the redwood has been cleared away entirely?

It may indeed be a matter for congratulation, that the redwood forests of the State are confined to the immediate vicinity of the coast; that Providence has placed them where it did. It is alone due to this fact, that we may hope, in a great measure, to escape the evils which probably would

otherwise follow from denuding so vast an area of forest land under ordinary conditions.

The writer hardly wishes to forecast coming events, yet it certainly is a gratifying fact that back of the redwood belt a well wooded country exists, capable, probably, of holding its own, even after the redwood is gone; that the peculiar location of the redwood lands is such, that owing to their direct exposure to the sea wind and fogs, a deficiency of rainfall, however reduced it may become, is hardly to be anticipated. That, furthermore, no single navigable stream exists, emptying directly into the ocean from the Coast Range, and that, therefore, the evil to be anticipated from all causes is reduced to the absolutest minimum conceivable. It may even transpire that interior districts, reaching back some distance from the coast, may receive an increased deposit of atmospheric waters, and be thereby benefited, if the influences which are apparently at work at present about Fort Gaston and the Klamath River are a gauge of what may be anticipated at other points in the range. The figures in Table H indicate that this may not be always probable, and that the decreased rainfall on the coast may be responded to by equally diminished rainfall in the interior.

What the influence may be upon the head sources of the Sacramento River, if an effect is to be anticipated at all, it may be hard to outline. They may receive additional waters; they may, however, be robbed of a great portion of their present supply—just according to whether the moisture-laden air currents continue to impinge on the high divide of the Trinity and Salmon Rivers, or whether they be forced up so high as to pass over these ranges entirely, in which event it would be difficult to foretell where their waters would be deposited. We have diverged, upon debatable ground, however, and prefer leaving the subject to those fond of abstract speculation.

The influence which forests exert upon springs and watercourses is so generally admitted that it would be almost superfluous to cite special cases. The influence which, among the heavy redwood, is notable, is beyond that to be ordinarily found. Many streams are instanced whose flow seems hardly affected at all by the seasons—which, after heavy rains, show a hardly perceptibly increased flow, which, after considerable periods of dry weather, still continue to carry their normal quantity of water.

THE OPERATION OF EXISTING LAWS UPON OUR FORESTS.

THEIR INFLUENCE UPON THE LUMBER PRODUCING INDUSTRY.

The estimates of the forest resources of the Coast Range, which are to be found in tables A and F, lead to the conclusion that we may reasonably expect, within a century or so, to see the best forests of the State denuded at least, if not entirely swept out of existence.

Merely regarding these as stores of a valuable raw material, consideration of the future wants of the State may suggest the expediency of casting about for means of preserving California from the evil of an exhausted timber supply.

Cheap lumber is a want of the people as a whole, regardless of class or occupation, and, economically considered, our forests are in just such measure as they continue to produce cheap lumber, a premium on all of the industries of the State, in just so much protecting them from outside competition.

To preserve a lasting supply of cheap wood may well be an object of solicitude to those officially charged with caring for the prosperity of the State. Even considerable outlay, if it conserve this purpose, will prove strict *present* economy and not a sacrifice solely for the benefit of coming generations.

Whether it be better policy to guard our present supply—in as much as it still remains public property—or create new resources, is aside from the present question, and is to be determined by considerations other than those referred to.

That the methods by which our forests are being exploited is not an economical one is patent, and a feeling akin to impatience suggests itself when we consider the small amount of the resource which is converted to useful purposes.

In a portion of the report devoted to inquiry into the efficiency of our present methods of operation, however, the conclusion was reached that at least as far as woods possessing a recognized status in the market went, willful waste did not prevail; that other intrinsically valuable woods were being systematically destroyed, however, without any return to the wealth of the community.

Our forests are, in a great measure, going to waste, without compensating benefit to any one, purely because the amount of available raw material is so much in excess of what can be turned to account, and this being the case, overproduction is an unavoidable result.

The class which so far has borne the evil consequences of this unnatural order of things has been mainly the producing class, as is always the case when a market cannot keep pace with the normal powers of production of the industry which supplies it.

It has ever been the beneficent policy of our Government to grant to the settler a home, to open up to development the natural resources of the country as soon as conditions were attained under which these resources could be developed and turned to account in enhancing the general prosperity. The Government considering itself, as it were, the custodian of the public domain, which remained in its hands until a growing demand for

its lands arose, opening them up to settlement. Hereby it has never been doubful that, in addition to the small sum paid to the Government for the lands ceded—if any payment were made at all—it looked to reap the indirect benefits accruing to the State from increased settlement and cultivation and the augmented prosperity of its people. The enactments prescribing the mode of appropriation of land, all bear testimony to this intent; and reservation is always made, or implied, that the appropriation be for the individual benefit of the locator himself, and not for that of third parties.

While acknowledging the principle, it is undeniable that exceptional conditions demand special consideration, and that where permanent settlement, from the very nature of the land appropriated, was not to be reasonably anticipated, other principles should have applied.

It is in the nature of the redwood lands, that for clearing and settlement they were unfit; that even when cleared, their value for agricultural purposes, from many reasons, should be but nominal, and that however great their intrinsic value might be, to the settler with small means, and with only a restricted holding—not to exceed one hundred and sixty acres—they would be of value only to the extent of the price which he might hope to receive from purchasers. And what is true of the redwood, holds good in a great measure for the great majority of other timber lands, although in lesser degree.

Redwood lands are valuable only to those who have the means to convert their timber into marketable products. The expense of milling plant and the thousand and one adjuncts to redwood lumber manufacture, are so great, as to be entirely beyond the means of those seeking a home on small holdings; so great in fact that only the assurance of large timber reserves, guaranteeing a run of a number of years, warrants the erection of a mill at all. The possession in fact, on the part of the mill owners, of several thousand acres of land, at the least, is a primary condition for operation at all. For purposes of actual settlement, a redwood claim is a perfect white elephant to the settler; clear it, he cannot; utilize its timber by his own unaided effort, he cannot; if cleared, the extent of his holding will fail to support him and his family. All through the redwood belt, for miles and miles one may travel, and no signs of present occupation are met with, save here and there on the traveled roads, where the transient travel is such as to warrant a stopping place; nothing but deserted shanties are found, save on natural openings, never covered with redwood timber at all.

Under conditions like these, it was inevitable that the redwood lands should sooner or later be concentrated into the hands of a few.

We judge by the light of subsequent events; the prediction which might have been made has become a reality. The finest forest in existence has, within a decade or two, passed from the hands of the people at large; has passed or is rapidly passing out of the hands of the original appropriators, into the hands of a few, and its destruction within the coming century is certain to transpire. Rightly understood in time, the question arises whether the Government might have not made better terms for itself—have reserved control of the resource and the power to perpetuate the same for ages to come, and have left the industrial class now engaged in stripping the forest better off than it is to-day.

Notwithstanding all restrictions and reservations, redwood lands, since they passed out of the Government's hands, have been matters of bargain and sale; are to-day commodities held for speculative purposes; and as far as actual settlement of the lands themselves, they stand unoccupied, unutilized, as they did twenty years ago.

A resource which it has been estimated is liable to meet the wants or the market for a hundred years to come is still, to a great measure, floating about, finding purchaser after purchaser at enhanced figures, and the price now readily paid for redwood lands varies, according to quality and location of its timber, from three-fold to twenty-fold that which the Government received for the same, and prices are sure to keep on increasing. By the time things have found their level, the value which redwood lands will then represent will necessarily increase the price of lumber materially, and though at present there are perhaps woods enough of other kinds on the public domain sufficient to guarantee the price asked for redwood from becoming excessive for a considerable number of years, we may anticipate marked rises in the comparatively near future. We will then pay in the enhanced price of lumber the penalty for short-sighted policy in the past.

What this penalty will be, will in a very great measure depend upon what care is taken to guard and reserve at least temporary control of the other forests of the State, which still belong to the General Government, and which may be made the subject of future legislative enactments: whether the people deem it advisable to let other forests pass out of their control, until there remain finally nothing left to guard; whether they elect to continue a system under which amounts of timber far in excess of what can be utilized, pass into private and speculative hands, or whether, grown wiser by the light of past experience, a system be inaugurated under which timber lands shall be sold or otherwise thrown open to exploitation, only in such quantities as the legitimate current want demands.

It has been already stated that under conditions like those now pertaining, overproduction was a necessary consequence; and also, that the class which had so far suffered most from an unnatural order of things, was the producing class itself. This is easily seen.

In the first place, as lands center into the hands of new combinations of purchasers, the necessity usually presents itself of these holdings, in order to produce some present return, being made the basis of separate operations. New mills are constantly being built, notwithstanding the fact that the capacity of the present mills is almost double their actual output. Hereby the intensity of competition is augmented. The older establishments are those most liable to suffer, as the newer ones generally have the advantage (for the time being, at least) of virgin ground to work upon, therefore cheaper logging expenses; and moreover, are usually equipped with plant possessing the advantage of modern improvements which older mills may lack.

In the second place, the already existing establishments, to guard themselves against the competition above referred to, naturally seek to accumulate lands for which they at present have no need. By this means, in mere self protection, probably, they are forced to bear the onus of taxation upon lands not needed or utilized, besides the loss of interest upon unproductive capital.

It follows directly that under these conditions, combinations seeking to artificially keep up prices to such extent as may offset the additional expense of manufacture, will necessarily be sought to be brought about, and which, while these combinations last, only shifts the burden upon the consumer; the public suffer.

This order of things is thoroughly artificial and unhealthy, and the cause rests solely in the fact that laws good in themselves, perhaps, were permitted to apply to conditions which they did not fit.

Waste, low efficiency in manufacturing methods, the destruction of valuable timber for which no present market exists, nor for which any market

can be readily created, seeing that the absorbtive power of the present market is fully responded to with supplies of the standard woods; all the objectionable features which force themselves upon the notice of the superficial observer even, these may all be referred to one fundamental cause, and are the necessary result of ill-advised, say rather misapplied, laws.*

In connection with the subject of inadequate legislation, it is considered a duty to call attention to the present State laws regarding the purchase of State school lands, and to point out the course which matters have but too often taken, where this law has found application to timbered lands.

The law permits entry of school lands upon a system of partial or installment payments—twenty per cent of the price of the land sufficing to hold it. At what time subsequent payments are made is to a great measure optional with the purchaser, the State receiving interest in the meantime upon the amounts standing unpaid. When applying to timbered lands, whose value often lies in their timber solely, a fair opportunity for evading the spirit of the law is afforded, as only a fractional payment allows the purchaser to strip the lands of their timber; after which, in default of further payments, they revert to the State. Such cutting of timber on the purchased land is prohibited under statute. Yet there are frequent cases in which the lands have been stripped and no knowledge of the fact being officially known, punishment has not ensued.

My letter of instructions from the Board, calls upon me to report to what extent the cutting of timber upon government land had been practiced. A more specific answer cannot be given than that the practice, on a greater or less scale, has been common. The attention of the Board may, however, be called to the fact that so much latitude exists in regard to the amount of timber upon mineral land, which may be considered admissible under the existing statutes, that it may not always be easy to determine where legitimate use terminates and transgression begins.

A recent enactment of the Commissioner of the Land Office, requiring count being kept, at the mill, of the quantity of lumber cut, and only permitting it to be sold to parties furnishing sworn statements that it is for their own private use and for purposes of home consumption, is, however, a step in the right direction.

The unsalutary influence which our present land laws have exerted upon our forests, and also upon the industrial branches depending upon our forests for their supplies, has been pointed out. Further than this your Engineer does not feel it within the province of his duty, nor within the scope of his ability, to go.

The subject is submitted to the Board with confidence, that when the proper time for decisive action has arrived, it will be prepared to outline a course of legislative enactments commensurate with the needs of the case.

*In Appendix D, an extract from the report of F. B. Hough to the Commissioner of Agriculture, 1878-1879, is reprinted. The officers of the United States Government have long recognized the inefficiency of our laws as applied to forests, and have not failed to bring the subject to the notice of Congress. Yet little or nothing has been done.

CONCLUDING REMARKS AND RECOMMENDATIONS.

It has been attempted in the preceding report to convey a correct idea of the forests of the Coast Range—their extent and character—as far as they have yet been studied, and to consider the various influences which touch their preservation or destruction. It has also been attempted to trace, as far as possible, the effect which their exploitation has so far had upon physical conditions, and to note any signs of climatic change which may as yet be noticeable.

The desire to place before the Board for its consideration and guidance the facts gathered, as nearly as possible in their original form—as little influenced by the writer's personality as might be—has increased the dimensions of the report beyond what was contemplated, and made it more lengthy than was desired. It was essential, however, that the mode of treatment should be an economic one, which made it necessary to consider many questions at considerable length, in order to arrive at correct conclusions.

Where conclusions had to be drawn for completeness sake, an earnest effort was made to keep to the facts, and to avoid drawing inferences which did not rest on solid foundation, and which, however tempting, might be open to dispute.

It is in the nature of a partial report that no general and wide reaching final conclusions can be drawn, and but few recommendations be made, although several desiderata will suggest themselves in the articles themselves. There are certain lines of action, however, which undoubtedly can be advantageously inaugurated by the Board and which will certainly be productive of good.

To husband the resources which nature has given is a matter of essential importance, and there is perhaps no more effectual way of accomplishing this end than by striving to create a sense of the intrinsic value of our woods. Whatever is not esteemed is either wasted or left fallow and is subject to thoughtless sacrifice upon slight provocation.

An impression prevails that California is utterly deficient in hard woods. This is not the case. Hard woods are not characteristic of the country, but abundant supplies of these exist. Much of our oak is of prime quality; the yew and mountain mahogany, although not very extensively represented, are excellent woods; the madroña and laurel are both valuable, and we have besides pines which are tough and elastic. Of the ash, some is of good quality, although ash is rather a rare wood. Raw material abounds, but the raw material of trees, like all raw material, needs proper treatment to make it valuable, and what proper treatment is, can only be determined by study and experiment. These the agriculturist has neither time nor the necessary facilities for determining.

There is no reason why California should not produce her own supplies of hard woods instead of importing them.

The cause of so much fine wood going to waste is simply that there is no market for it. This can at least be remedied. It is suggested to the Board the desirability of its undertaking the task of introducing our woods into more general use; to determine their value, and to make study of the peculiar modes of treatment which they require, and to disseminate,

as widely as possible, the knowledge acquired, for which purpose bulletins of progress may from time to time be issued, and be either gratuitously distributed to those making application for them, or sold at a price adequate to cover the cost of publication and preparation; that it, besides this, see to the creation of a department ready to supply information when requested of it. Falling entirely within the lines of this idea, there is probably a field for devising methods for utilizing much of the waste product of our woods; probably both the fibers of the redwood bark and the sap-juices of the wood, for example, having value, if the subject were but carefully inquired into.*

If markets are established for our woods, even in outlying districts, care will be taken to guard that which, in course of time, will bring cash returns.

Indiscriminate opposition to all tree-cutting is not the aim of forestry, although there are those who conceive such to be the case, and fail to ascribe to the word any further significance. To *utilize* that which is ripe for utilization is sound policy, and should be encouraged. Such utilization should, however, go hand in hand with methods of replenishment.

The special methods of accomplishing the desired end require careful study, for which time and opportunity has not as yet been allotted. It is unquestionable, however, that a wide field for forestry exists in this State.

The report, unless it has missed its mark, can hardly fail to create the impression that, as regards our forests, matters are in a bad way, and that injudicious legislation is responsible for much of the bad state of affairs. The evil is one which only time will correct;—which better enactments even, would now fail to reach. It is undeniable that something should be done to protect our forests, if only to guard against their exhaustion, danger of which threatens. Statutory legislation—however much it may aid—will not alone prove adequate; our forests need care. It is not without outlay that the evil consequences of a too extensive encroachment upon Nature may be sought to be warded off; time, money, and labor will be required. It is believed, however, that the burden of expense can be so distributed, as to fall lightly upon the community, until a state of equilibrium is brought about, after which little more than a general supervision will be called for.

The opinion is hazarded, that if remedial measures but keep pace with the destruction, the resources of our forests may be freely utilized without evil consequences ensuing. The efficiency of the forests at certain points should be maintained or stimulated. If this be but judiciously carried out, we may hope to realize a compensation in the increased efficiency which may be imparted to lands now of little value.

It is, however, essential, as a basis for intelligent action, to possess a thorough knowledge of the forests of the whole State—a subject which cannot be too carefully studied—and to the accomplishment of which worthy end, this report—with all its shortcomings and defects—hopes to be a first step.

* Highly conducive to the same end will be found the award of cash premiums and honorary testimonials to those who may successfully devise methods for accomplishing things which the studies of the Board may lead it to consider possible. This will bring the subject to wide consideration, and contribute to the lasting prosperity of the State.

APPENDIX.

APPENDIX A.

" *There is equally good reason for believing that, in the infancy of the art the efficiency was hardly more than 20 per cent.*" *Page 149.*

The Superintendent of one of the largest mills in Mendocino County, where logs were, to a considerable extent, still run in drives, stated that he estimated the average tree to yield from three to four logs—of which the butt log always was a sinker and frequently the second cut also. These are left to dry out on the river banks and are often grown up with bush and forgotten, or are left in the woods if it does not pay to rebuild skidways that perchance have rotted out in the meantime, or often put into the river only partially dried out, go to the bottom before reaching the boom. From all these causes he estimated that not more than one half of the sinkers ever had reached the mill, while water transportation alone was used.

From this cause alone only $\frac{5}{6}$, say $83\frac{1}{3}$ per cent, of the logs in the tree reached the mill (say $\frac{1}{3}$ sinkers; $\frac{1}{2}$ of $\frac{1}{3} = \frac{1}{6}$; $1 - \frac{1}{6} = \frac{5}{6} = 83\frac{1}{3}$ per cent). Other causes, generally slacker methods, etc., may easily have reduced this 83 per cent, say 10 per cent, making the percentage of logs actually sawed only 73 per cent say, of what, under present methods, would be cut—and the product of lumber sawed proportionately reduced. The present efficiency is 28 per cent, which might indicate the original efficiency not to have exceeded 73 per cent of 28 per cent $= 20\frac{1}{2}$ per cent.

" *The extreme limit of efficiency, which he may ever hope to attain, will not exceed 40 per cent.*" *Page 149.*

On page 139 we assumed that 65 per cent of the standing tree reached the mill in form of logs, and stated 63 per cent as the coefficient corresponding to Spaulding's Scale. This would leave 63 per cent of 65 per cent = 40.95 per cent, which efficiency would only be attained when all the inherent obstacles to economical sawing of redwood were entirely overcome, and logs of redwood sawed with as little waste as pine and spruce. To exceed this maximum, improved appliances in redwood manufacturing can hardly aspire!

APPENDIX B.

THE SUGAR PINE; ITS PECULIAR DEVELOPMENTS IN DEL NORTE COUNTY.

As distinguished by the color and the general appearance of the bark, at least three distinct types of the sugar pine proper exist.

First—The typical sugar pine, with its rich, reddish-brown, even, small-lamellated bark. Of this type noble specimens, six and even eight feet in diameter, may be seen, generally at altitudes hardly less than three thousand feet, and probably extending up to above five thousand feet, although I personally have not seen them growing higher than four thousand three hundred and fifty feet in this part of the range.

These trees are often two hundred feet in height, and sometimes more, with the first limbs one hundred feet from the ground; sixty or seventy feet is, however, still exceptional, and many well grown trees are clothed with branches to within twenty feet of the ground. Thirty to thirty-five feet is, however, the common height.

Of this form of sugar pine, growing well up on the trail between Waldo and the Klamath River (Happy Camp), and on the slope facing the Klamath, trees were observed showing particularly adherent bark, though otherwise not differing from the general appearance of sugar pine bark, save that the clothing of the trunk, due probably to the number of superposed layers, is less smooth and even and is more water-channeled than is usual with the general run of trees. One piece of bark, casually picked up, showed no less than twenty-two superposed scales, and the innermost scales were missing.

Second—The type of sugar pine not uncommon in the upper coast counties, slender of shaft, generally not much over two feet thick, almost black in color of bark, and seldom appearing as a tree larger than one hundred or possibly one hundred and twenty-five feet high. Trees of this kind are especially common on the sunny slopes of the Klamath River. The wood of these trees shows a thicker and more prominently defined sapwood, and the heartwood is less soft than in the brown barked trees.

Third—Trees whose bark can only be compared to hammered silver, the bark being uniformly smooth and showing no water channels, and the scales being only defined to the extent of resembling hammer-marks, the ashy tint being purely silver tinged in the strictest sense (like the dead surface of molten silver newly fractured, or the fine-grained exterior of freshly cast silver bars). Trees of this kind may be found just south of the "Robin's Nest," on the trail from Gasquet's to Waldo, and they are often three feet in diameter and one hundred feet in height, with limbs fifty feet from the ground. The cones are hardly smaller than the average run of sugar pine cones, which generally do not exceed fifteen inches in length. They are, however, strictly of the sugar pine type, and do not resemble those of the *Pinus monticola*. The foliage is that of the ordinary sugar pine, but partakes of the silvery character of the trunk, and is more silver-gray than bluish.

Among woodsmen in this district, the names "silver pine" and "mount-

ain white pine" are commonly spoken of, and they are well distinguished from "sugar pine" in the local phraseology. Of the wood of the former tree, I am indebted to Mr. John Douglas, of Bunker Hill, for the following description, and from comparing notes with him I have little hesitation in connecting it with the trees of the Robin's Nest. Mr. Douglas says: The silver pine works entirely different from ordinary sugar pine; it is exceedingly heavy when cut, and exceedingly light when seasoned; it does not show a white sapwood and creamy tinted heartwood, as does sugar pine in general, but sapwood, heartwood, and core are uniformly white. The wood is very fine grained, but is stringy, tough, and elastic, both when green and when seasoned. It dresses smooth and works beautifully, does not check under exposure to the sun, and sluice boxes which are made of it may be left dry all summer without being affected. Trees are found up to four and four and one half feet in diameter, and they are more apt to be found above the sugar pine than with it.

The most peculiar tree, however, is a dwarfed pine of the sugar pine family, which is found on the wind-swept ridge north of Gasquet's, and which may, when thoroughly studied, even be classed as a variety by itself. Where first seen, it grew among *P. tuberculata* and *P. contorta* as a tree not taller than thirty-five feet in height, but distinctly possessing the whole habit of the sugar pine. The fully matured cones are not longer than four inches in length, two inches and a quarter in width when opened out, and the green cones are bright-purplish crimson. They pend from the tips of the boughs, as do the cones of sugar pine. The bark is grayish white and very persistent, not showing scales at all detachable, although distinctly water marked, and is divided into square or hexagonal checks, the trunk more resembling in general appearance the trunk of *Quercus Garryana* than that of any of the conifers. The foliage is five leafed and very finely leafed, but otherwise not differing from the foliage of sugar pine. From one specimen not four feet high three well-matured red cones were taken (in the second year of their growth), and these measured three inches in length by one inch and one quarter in width, but exactly resembled the ordinary large unopened sugar pine cone, save for the color.

The only reason for supposing that the tree may, when properly studied, deserve classification as a separate variety, and not be only another instance of the disposition of all California trees to show fully matured dwarfed growths, as well as abnormally large specimens, lies in the fact that several miles north of where these dwarf pines were first seen, a large specimen, not less than seventy-five feet in height, but hardly a foot in diameter, and preserving all the distinctive features of the trees described—white checkered bark and red cones pending from the ends of the limbs, included—grows immediately alongside of normal dark barked sugar pines.

The writer, from general points gathered from woodsmen, believes this to be the "mountain white pine," so often spoken of by them, and which is said to frequent the wind-swept rocky summits of the Siskiyou Range, at elevations higher than those which the sugar pine attains to. The wood is said to be very close grained, and very tough.

NOTE.—Whether I am correct or not in applying this description to the silver-barked sugar pines of the Robin's Nest, the description comes from a reliable source and is valuable, especially should it call attention to some valuable pine not as yet referred to the Coast Range.

APPENDIX C.

The acknowledgments of the State Board of Forestry are especially due to the following gentlemen, for aiding the progress of the Engineer and furnishing facts of special value to his report, or for contributing detailed information which has been embodied in the forest maps which accompany the report:

To J. W. Bagley, C.E., Guerneville, Sonoma County.
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To Wm. Heeser, Mendocino City.
To Chester Ford, Superintendent of Mendocino Mills.
To James Brett, Superintendent Albion Mill.
To Allan McCallum, of Mendocino City.
To Chas. R. Johnson, Superintendent Fort Bragg Mills.
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To J. D. Ward, Deputy County Assessor, Cahto, Mendocino County.
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To Wm. Bowers, Blocksburg, Humboldt County.
To Alexander Connick, Superintendent Occidental Mill Company, Eureka.
To J. W. Henderson, Eureka.
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To Wm. Carson, Eureka, Humboldt County.
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To D. R. McIntosh, Eureka, Humboldt County.
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To A. T. Smith, C.E., County Surveyor, Humboldt County.
To J. D. Ackerman, Deputy County Assessor, Humboldt County.
To Carl C. Marshall, Arcata.
To M. G. King, C.E., Oakland.
To Noah H. Falk, Arcata, Humboldt County.
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To Henry Solms, San Francisco.
To Henry Harvey, County Surveyor, Del Norte County.
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To General J. G. Wall, Crescent City.
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To A. J. Van Matre, Deadwood, Trinity County.
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To all these gentlemen, and to the numerous others who have taken part in furthering the work of the Board of Forestry, thanks are herewith tendered.

To William Hammond Hall, State Engineer, the Board would express the sense of its obligation for the exceptional courtesy of permitting it the use of the valuable State maps, in advance of publication by the department which he heads.

APPENDIX D.

Reprint from the Report of the Hon. F. B. HOUGH to the Commissioner of Agriculture, 1878-79.

It will be observed that ideas of the conserviency of forests, or the wants of the future, are entirely overlooked in the anxiety to satisfy the current wants of the present time. To one unacquainted with the conditions that actually exist the supplies of timber might be thought inexhaustible in amount and infinite in duration, yet nothing can be more fallacious than this, as the near future must assuredly prove. Without further considering the discussions thus raised, it remains for us to notice the several Acts passed at the second session of the Forty-third Congress, having direct reference to the timber upon the public lands.

In relation to the waste going on upon the public lands in the cutting of the redwood and giant trees in California, the Secretary of the Interior in his annual report for the year ending June 30, 1879, says:

The waste and destruction of the redwood (*Sequoia sempervirens*) and "big trees" (*Sequoia gigantea*) of California have been and continue to be so great as to cause apprehension that these species of trees, the noblest and oldest in the world, will entirely disappear unless some measure be soon taken to preserve at least a portion of them. I am informed that in the more inaccessible sections of the Coast Range in the northern and on the west side of the Sierra Nevada Mountains in the southern section of California, some forests of these trees still remain that may and should be preserved either wholly or, at least, in part. The importance of preserving these species of trees in sufficient quantity to serve to this and coming generations as an illustration of the magnificence of the grandest of primeval forests is so great as to have attracted the attention of men of science in both Europe and America, from some of the most eminent of whom I have received communications on this subject. It is especially desirable that the big trees in the above named localities be preserved, as the "Mariposa Grove," now celebrated for its specimens of that species, is small, and many of the large trees in it are injured by fire.

I would, therefore, recommend that the President be authorized to withdraw from sale or other disposition an area at least equal to two townships on the Coast Range in the northern, and an equal area in the southern part of the State of California, the precise form and location of the tracts to be determined at his discretion.

The Secretary of the Interior, in his report for the year ending June 30, 1879, makes the following statements and suggestions in respect to depredations on the public timber lands:

I deem it my duty again to invite the attention of Congress to the depredations committed on the timber lands of the United States and the necessity of the enactment of laws calculated to arrest the indiscriminate destruction of our forests, especially the mountainous regions of the country. Since my last annual report the only action taken by Congress toward the suppression of timber depredations consisted in the appropriation of $40,000, provided for by the Act of March 3, 1879. Under this appropriation a maximum force of fifteen special timber agents was employed to investigate trespasses in the various public land States and Territories. These agents were from time to time transferred from one field to another, as it was thought that they could best serve the public interests.

The labors of these agents have been fruitful of good results in two directions: First, in collecting testimony for the prosecution of trespassers and for the recovery of the value of timber unlawfully taken from the public lands. It was predicted by many opponents of the policy pursued in this respect by the Department that the cost of the investigations and prosecutions would not be covered by the proceeds, and that therefore the money appropriated and spent for this purpose would in a great part be money thrown away. This prediction has not been justified by results. The sum covered into the Treasury

during the last fiscal year on account of timber depredations was largely in excess of the sum appropriated, and a considerable number of cases is still pending in the Courts awaiting trial, which will, when judgment is obtained, very much increase the amount already recovered. The details are presented in the report of the Commissioner of the General Land Office. The prosecution of depredators on the public timber lands has, therefore, been a well-paying business to the Government.

This, however, is the least important result of the operations of the Department in this respect. Of far greater consequence is the fact that the investigation of trespasses and the prosecution of depredators, carried on with vigor and earnestness, although with very limited means, have created in some of the localities where the depredations had been most extensive, a wholesome respect for the law, and strengthened the desire of good citizens, who have the interests of the country at heart, to see the unlawful destruction of the public timber cease. It is indeed gratifying to observe that the interest in this important question which the measures adopted by the Government have awakened, and the discussions which have followed, have greatly weakened the opposition which existed at the beginning to the policy pursued by this Department. Even in the States and Territories where the timber necessary for domestic and business purposes can be obtained only from the public lands, unless imported from a distance, a healthy public opinion seems to be springing up which recognizes that an indiscriminate destruction of the forests, and especially the denudation of the mountain slopes of the timber growth covering them, must inevitably result in incalculable and irreparable injury to the economical interests of those States and Territories, and become ultimately destructive to the prosperity of their people.

This is an observation which by painful experience has forced itself upon every civilized nation on earth; and it is to be hoped that the American people will become mindful of it while it is yet time to remedy the evil already wrought by the reckless improvidence which has so far prevailed.

While the measures taken by this Department have undoubtedly produced a good effect in many localities, it must be kept in mind that the limited means allowed by Congress permitted only a comparatively small field to be covered by its operations. The greatest danger of a wholesale destruction of our forests, and of the disastrous consequences that destruction will bring after it, exists in those States and Territories where the timber indispensably required for domestic use and local industry must be taken from the public lands, there being no timber lands in private possession, and the public lands being mostly unsurveyed and not subject to purchase or entry.

In my last annual report I discussed the inadequacy of the laws enacted by the last Congress "authorizing the citizens of Colorado, Nevada, and the Territories to fell and remove timber on the public domain for mining and domestic purposes," and providing "for the sale of timber land in the States of California and Oregon and in Washington Territory." The opinion I then ventured to express, that the first of these Acts would be taken advantage of not only by settlers and miners to provide economically for their actual current wants, but by persons who would see in this donation a chance to make money quickly; that it would stimulate a wasteful consumption beyond actual need and lead to wanton destruction, and that the machinery left to this Department to prevent or repress such waste and destruction through the enforcement of rules to be made by the Commissioner of the General Land Office would be found insufficient for that purpose, has already in many places been verified by experience; also the predictions made by the Commissioner of the General Land Office with regard to the effect of the second one of the above named Acts. Referring to what was said about these laws in my last annual report, I repeat my earnest recommendation that they be repealed, and that more adequate legislation be substituted therefor.

It is by no means denied that the people of the above named States and Territories must have timber for their domestic use as well as the requirements of their local industries. Neither is it insisted upon that the timber so required should be imported from a distance, so that the forests in those States and Territories might remain intact. This would be unreasonable. But it is deemed necessary that a law be enacted providing that the people may lawfully acquire the timber required for their domestic use and their local industries from the public lands under such regulations as will prevent the indiscriminate and irreparable destruction of forests, with its train of disastrous consequences. It is thought that this end will be reached by authorizing the Government to sell timber from the public lands principally valuable for the timber thereon, without conveying the fee, and to conduct such sales by Government officers under such instructions from this Department as will be calculated to prevent the denudation of large tracts, especially in those mountain regions where forests once destroyed will not reproduce themselves. I have no doubt that under such a law, well considered in its provisions, the people of those States and Territories would be enabled to obtain all the timber they need for domestic as well as industrial purposes at reasonable rates, and that at the same time the cutting of timber can be so regulated as to afford sufficient protection to the existence and reproduction of the forests, which is so indispensable to the future prosperity of those regions. I venture to express the opinion that the enactment of such a law has become a pressing necessity, and cannot much longer be delayed without great and irreparable injury to one of the most vital interests of the people. I therefore again commend to the consideration of Congress the bill introduced as Senate Bill No. 609 in the last Congress.

The subject of the destruction of forests by fire also calls for early and earnest attention. In most, if not all, of the States where timber lands are in private possession, the

setting of fires in them is made a highly penal offense by statute. But there is no law the United States providing specifically for the punishment of such offenses when co mitted on the public lands. It is a matter of experience that such fires on the pub lands of the Western States and Territories are sometimes set by Indians, but in majority of cases by hunters, mining prospectors, and tourists, who negligently lea their camp-fires burning when moving from place to place, as well as by persons w deliberately set timber on fire for the purpose of deadening and thus preparing it for p ticular use. It is said that larger areas of timber land are devastated by such fires th by all other kinds of depredation, and this is probably true. I therefore repeat the reco mendation made in my first annual report, that a law be enacted prescribing a seve penalty for the willful or negligent setting of fires upon the public lands of the Unit States, and also for the recovery of all damages thereby sustained. It may in many cas be difficult to obtain the testimony necessary for the conviction of persons guilty of th offense; but if the law is successfully enforced only in some instances, it will serve direct general attention to the danger to which any one who willfully or negligently sets fi to public timber exposes himself, and thus to make many persons, who so far have giv no thought to the possible consequences of their negligence or recklessness, more caref in the future.

I would also repeat the recommendation made in former reports that the President l authorized to appoint a Commission, composed of qualified persons, to study the laws an practices adopted in other countries for the preservation and cultivation of forests, and t report to Congress a plan for the same object, applicable to our circumstances. The tim is fast approaching when forest culture will be to the people of the United States a important a question as it is in older countries; and then it will be a subject of painfu wonder to thinking men, how it could have been so long neglected.

ARBOR DAY BILL,

TO BE OFFERED FOR ADOPTION AT THE SESSION OF THE LEGISLATURE OF 1887.

AN ACT TO ENCOURAGE TREE PLANTING WITHIN THE STATE OF CALIFORNIA.

The People of the State of California, represented in Senate and Assembly, do enact as follows:

I.

The last Saturday of each month of January hereafter following is hereby declared to be a legal holiday, and shall be known and observed as "Arbor Day," and shall be devoted to the planting of trees.

II.

The State Board of Forestry is hereby authorized and empowered, for the purpose of encouraging individual planters of trees in forest form, to offer, in behalf of the State of California, such reward or rewards, not exceeding the aggregate sum of one thousand dollars ($1,000), annually, as the said Board may deem expedient, such rewards to be bestowed in the order of merit upon such planters of trees in forest form within the State as the said Board may find most deserving of distinction therefor; but no reward shall be bestowed for trees now already planted in forest form, and no reward shall be bestowed more than once upon any same forest of trees.

III.

For the purpose of carrying out the provisions of the section last preceding, the annual sum of one thousand dollars ($1,000) for each year is hereby appropriated, and the Chairman of the said Board shall draw on the Auditor of the State his warrant, countersigned by the Secretary of said Board, payable to the order of the person upon whom any reward by this section provided for may be bestowed, and upon the receipt thereof, duly indorsed, the Auditor shall draw his warrant on the Treasurer of the State for the amount therein named, and the same shall be paid by said Treasurer out of the one thousand dollar ($1,000) appropriation by this section made.

IV.

This Act shall take effect and be in force from and after its passage.

TREE CULTURE EXPERIMENTS

MADE BY THE

SOUTHERN PACIFIC RAILROAD COMPANY.

TREE CULTURE EXPERIMENTS.

Made by the Southern Pacific Railroad Company.

The following letters relating to the experiments of the Southern Pacific Railroad Company will be found of interest, and more especially to those who have undertaken the culture of the different varieties of eucalyptus:

SOUTHERN PACIFIC COMPANY, SAN FRANCISCO,
November 5, 1886.

ABBOT KINNEY, ESQ., *Chairman State Board of Forestry, 42 Nevada Block, City:*

DEAR SIR: Your favor of the eighteenth ult., to Mr. Towne, having been referred to me, I inclose you herewith a report from Mr. John R. Scupham, made May 20, 1885, at which time the company practically discontinued its tree culture experiments.

I think you will find embodied in this report all the information that we are able to furnish on this subject; however, if you can suggest any other general information that you think we can supply, or should you desire more specific knowledge about result of tree culture in any particular locality, we shall be happy to furnish same if possible, or put you in communication with any of our agents who may be able to furnish data of value to your Board.

Yours respectfully,

W. G. CURTIS,
Superintendent of Track.

Mr. W. G. CURTIS, *Superintendent of Track, Southern Pacific Company:*

DEAR SIR: I beg leave to submit to you herewith a report in regard to tree planting along the line of railroad, and on the property belonging to this company.

In the year 1877 it was determined by the Directors to try the experiment of tree culture through the various sections of the country traversed by the lines of railroad controlled by the company, with the following objects in view:

First—To demonstrate the value and capability of the land.

Second—To test the value of certain woods for railroad purposes, and the practicability of their economic cultivation.

Third—To remove the sterile and forbidding appearance of the stations and section houses in the treeless plains and valleys, by surrounding them with fruit and shade trees.

It was determined to carry this work on under the Superintendent of Track, and it was specially put in my charge, with instructions to make the current expenses as small as possible.

My first effort was directed toward the culture of the rapid growing varieties of the eucalyptus on the margin of the right of way, where it was available, with a view to utilize the growth to test the economic value of the wood.

For this purpose some thousands of tree plants were purchased in the nurseries of Oakland and Haywards, and planted along the right of way of the lines running through Alameda County, California. The total number planted in this way was about forty-four thousand trees, mostly plants of the *E. globulus*, but including also a good number of the *E. amygdalina* and *E. rostrata*.

To anticipate this experiment as a test of the wood, about a thousand telegraph poles were procured, of the young growth of the *E. globulus*, or blue gum, and also some two hundred and twenty-eight fair-sized railroad ties of the same variety of timber. The telegraph poles were turned over to the department under Mr. Vandenberg, and were placed by him in the line along the San Pablo and Tulare Railroad. The railroad ties were placed in the track near Rose Creek, Nevada, on the Truckee Division, Central Pacific Railroad. This point was selected because it was found that there the destruction of ties by rot was extremely rapid.

Mr. Vandenburg's report of the test of the eucalyptus for telegraph poles showed that while they were strong and tough, and bore up the wire well under all circumstances, yet they did not last well, as they were inclined to rot in the ground; and just at the surface of the ground they were attacked by the larvæ of some large beetle.

The eucalyptus ties placed in the sandy soil of Rose Creek very quickly showed a tendency to check or crack in an extraordinary manner, so that in some cases it was found difficult to find a place on them suitable to hold spike; otherwise the ties were very strong, and lasted well.

After being four years in the track, Roadmaster Browning reported "no signs of decay." After being six years in the track, slight signs of rot were reported, and two out of two hundred and twenty-six were removed for being split.

After seven years in the track, two inches of rot was reported, and seventy-three were taken out of track. This would show the blue gum ties comparing in durability with best yellow pine, which is our best second class tie.

The trees planted along the right of way in Alameda County showed great thriftiness of growth, and in a few years demonstrated that wood could be produced in this way with surprising rapidity. In four years some of the trees had reached a height of twenty-four to twenty-six feet, and a diameter of eight to ten inches.

At this point it was deemed expedient to terminate the experiment, and the trees were cut down and used for engine wood.

In 1877 Mr. C. P. Huntington sent out a box of catalpa seed (*Catalpa bignonides*) with a strong recommendation that it be tested with a view to cultivate a plantation for tie timber. The wood of the catalpa is coarse grained and light, but it has the reputation of being "the most durable under ground of all timber." Cases are quoted of its lasting buried in the ground eighty years and upward, without showing signs of rot. (Ohio Agricultural Reports, 1871.) The Goshen branch, just built at this time, passed through a treeless region, where the land was very moist and very fertile, hence it was deemed a good place for the catalpa experiment, and a parcel of land, fifteen acres in extent, was selected for that purpose in the Town of Hanford, Tulare County, California.

This tract was planted with catalpa seed raised from the seed sent out by Mr. Huntington. The trees were set out eight feet apart, east and west, and ten feet apart, north and south. They throve remarkably well, growing almost as rapidly as the eucalyptus trees about San Francisco Bay; but in the course of time the company received what was thought to be a very advantageous offer for this land, and it was sold.

Though the experimental grove was taken out of our hands, it yet continues to flourish, and I learn from the report of the company's agent that these trees, which are now seven years old, have attained a height of from fifty to sixty feet, and are from eight to twelve inches in diameter. They have now, therefore, reached a size when some of the trees might be cut for ties. They were planted three hundred and twenty-six to the acre. If one fourth of these could be cut for ties, and, by splitting through the center as is suggested, four ties be made from a tree, this ground may be considered to already bear a very valuable crop.

It was considered that the most important work on hand was that of planting out about the station and section houses.

To have a cheap and convenient source from which to procure tree plants, it was determined to establish two nurseries, one in the northern and the other in the southern portion of California.

For the first a block of land belonging to the company was selected in the town of Chico. For the second locality we took a portion of the right of way, situated between Sumner Station and the Kern River.

The strong clay soil of Chico was relied on to produce the plants of the catalpa, locust, walnut, poplar, and certain fruit trees; while the sandy soil and hot climate of Kern River Valley was expected to produce the different varieties of eucalyptus, acacia, and pepper trees, and certain trees of arid habitat.

From these sources we soon had an abundant supply of tree plants.

In the Spring of 1877 the whole of the country east of Tulare Lake and south of the present town of Tulare, was an unoccupied waste, used only sparingly for pasture. With a view of demonstrating that this treeless waste could be made fit for homes, a half section of land was selected in the midst of this area, at a point just south of Tipton. This was inclosed with a fence, and planted with eucalyptus and acacia trees, and for their maintenance, an effort was made to get an artesian well, which resulted successfully. A good flow of water was obtained at a depth of four hundred and eight feet.

Stimulated with this water the tree plants grew fairly well and soon presented the appearance of a grove. The example was followed by settlers who bought land, and soon were sinking artesian wells and making homes throughout this section; showing that one object of the experiment had been accomplished.

We soon found, however, that the blue gum was too susceptible to frost to thrive permanently at Tipton. Each Winter biting, frosty air pours down from the mountains out of the cañon of Deer Creek, onto this particular tract, thus killing the tender blue gums in spite of their strong Summer's growth. An experiment was also tried at Delano. This station at that time was a sheep-shearing camp, and from its situation greatly troubled by malaria, so that at times all the inhabitants were stricken with fever and ague.

With a view of testing the efficacy of the eucalyptus trees as a preventive, four rows of the plants of the *E. globulus* were planted along the railroad track, which was so situated as to form a barrier between the town and Tulare Lake. These trees manifested an extraordinary growth.

The second year they were from twelve to fourteen feet high. From that time on cases of malarial disease rarely originated in the town. Before that the section men stationed

there usually went to the hospital after two months residence. Now it appears as healthy as any other station on the road.

The trees at Delano still flourish with unexampled vigor, enduring frosts that have cut down most trees of their kind in that section.

For this unusual hardiness there appears to be no special reason, and we must conclude that situations that are recognized as malarial are particularly favorable for the eucalypti.

The nurseries at Chico and Sumner (Kern River) furnished tree plants, and each Spring, during the season adapted to planting, they were distributed along the lines of railroad, and planted about the station and section houses.

In some localities, notably in Nevada, great difficulty was found in making the tree live. This resulted partly from the altitude and severe climate, and partly from selecting trees ill adapted to the locality.

It is true we knew that cottonwood and quaking asp, and the like, would flourish at the most difficult points, but it was deemed worth while to try what could be done with more desirable species, and with fruit trees.

In this way it was not by once planting, but by many times planting, that the stations in the treeless wastes were gradually embowered.

Often, even after trees were well started, the carelessness of an employé would allow them to die off again.

The situation at Kern River was found to be excellent for a nursery, but for the sake of economy it was abandoned in favor of Tipton, where the plantation and nursery could be consolidated. Most of the trees planted out along the Southern Pacific, as far east as El Paso, were raised in this nursery from the seed. In extending the tree planting through Arizona and New Mexico, an unexpected difficulty was encountered. We had looked for trouble from the heat and drought, but we found the most serious to arise from frost.

We never expected to find, as our meteorological observations now show, a minimum temperature of eight degrees and ten degrees for stations in Arizona. In consequence of this lack of sufficient data, the trees sent to that section for several seasons have been frost killed, as the first experience of this kind was thought unusual and exceptional and the same kinds were tried again. I believe I can now report that the present stations throughout California are sufficiently well supplied with living trees, so that, with reasonable care, the beauty and advantage to be derived from them will be constantly on the increase.

In Arizona and New Mexico, with our present experience, something more might be done. Mr. Muir, Division Superintendent, is especially anxious to have another effort made with the stations from Tucson east. Even should this be determined on, it will no longer be necessary to continue our nurseries at Chico and Tipton.

Yours respectfully,

J. R. SCUPHAM.

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No 11.—*Pinus ponderosa*, Dougl.—Yellow Pine, near Shasta. Alt. 4,000 feet.

SECOND BIENNIAL REPORT

OF THE

CALIFORNIA STATE BOARD OF FORESTRY,

FOR THE

YEARS 1887-88,

TO

GOVERNOR R. W. WATERMAN.

MADE IN ACCORDANCE WITH THE PROVISIONS OF SECTION FIVE OF AN ACT "TO CREATE A STATE BOARD OF FORESTRY, AND TO PROVIDE FOR THE EXPENSES THEREOF," APPROVED MARCH 3, 1885.

SACRAMENTO:
STATE OFFICE : : : : J. D. YOUNG, SUPT. STATE PRINTING.
1888.

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ERRATA.

Page 53, last line, for "follow" read follows.

Page 63, in the table, lines three and four, for "Chemæcyparis" read Chamæcyparis.

Page 84, in first head line, for "Short-cone" read Dwarf-cone.

Page 131, under Fungi, third paragraph, fourth line, for "Harkness" read Harkness'.

Page 140, in Dr. Engelmann's classification, fifth line, for "leaving" read leaves.

Pages 141–146, illustrations of cones, leaves, etc., for natural "size" read natural diameter.

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ARTOTYPE ILLUSTRATIONS,

By Britton & Rey, from Photographs by J. G. Lemmon.

An Act to Create a State Board of Forestry, and to Provide for the Expenses Thereof.

[Approved March 3, 1885.]

The People of the State of California, represented in Senate and Assembly, do enact as follows:

Section 1. There shall be established a State Board of Forestry, consisting of three persons, appointed by the Governor of the State.

Sec. 2. Each member shall hold office for the term of four years, and until his successor shall be qualified.

Sec. 3. The Board may appoint and prescribe the duties of its Secretary, and elect one of its own members Treasurer, both to hold office at the pleasure of the Board.

Sec. 4. The duty of the Board shall be to collect statistics and other information with regard to forestry, tree culture, and tree preservation, throughout the State; to correspond with various forestry societies and individuals, for the purpose of obtaining such information; to learn by investigation and experiments the adaptability of various trees to the different sections of the State; to disseminate such information throughout the State in such a manner as to aid and encourage the purpose for which this Board is formed; to assist in enforcing and carrying out all national and State forestry laws, as far as practicable; to act with a special view to the continuance of water sources that may be affected in any measure by the destruction of forests near such sources; to do any and all things within their power to encourage the preservation and planting of forests, and the consequent maintenance of the water sources of the State.

Sec. 5. This Board shall report biennially to the Governor a detailed statement of its work, which shall include all disbursements that may have been made. All printing required to be done by the Board for their official use shall be done by the Superintendent of State Printing.

Sec. 6. There is hereby appropriated for the use of this Board, out of any moneys in the State Treasury not otherwise appropriated, the sum of five thousand ($5,000) dollars for the two years beginning the first of April, eighteen hundred and eighty-five; said sum to be used for the payment of the salary of the Secretary, not to exceed the sum of one hundred and twenty-five dollars per month, the necessary traveling expenses of the members of this Board, the employment of assistants, and such other needful expenditures as this Board may incur, and the State Controller will draw his warrants on the State Treasurer in favor of the Treasurer of the Board for the same.

Sec. 7. The members of this Board shall receive no compensation.

Sec. 8. All Acts or parts of Acts in conflict with this Act are hereby repealed.

An Act to Enlarge the Powers of the State Board of Forestry, and to Provide for the Expenses of said Board.

[Approved March 7, 1887.]

The People of the State of California, represented in Senate and Assembly, do enact as follows:

Section 1. All the members of the State Board of Forestry of this State, and all assistants now employed or hereafter to be employed by said Board, are hereby endowed with all the powers of peace officers, for the purpose of making arrests for any violation of any law applying to forest or brush lands within this State, or prohibiting the destruction thereof.

Sec. 2. There is hereby appropriated for the use of this Board, out of the moneys in the State Treasury not otherwise appropriated, the sum of twenty-nine thousand five hundred dollars for the two years beginning the first of April, eighteen hundred and eighty-seven, said sum to be used for the payment of the salaries of the assistants of said Board, the necessary traveling expenses of the members of said Board, and such other needful expenditures as said Board may find necessary, and the State Controller shall draw his warrant on the State Treasurer in favor of the Treasurer of the Board for the same.

Sec. 3. This Act shall take effect and be in force from and after its passage.

REPORT

To his Excellency R. W. Waterman, *Governor of California.*

The State Board of Forestry of California has the honor to present its second biennial report, showing the scope of the work undertaken and the results achieved. From the separate reports of the officers herewith submitted, a complete detailed account of all the work done may be obtained.

The first efforts of the Board of Forestry during the period covered by this report were directed toward a reform in the cutting of the public forests on our mountain watersheds. The generosity of the General Government in the management, or lack of management, of its forest lands, and of the State with its school lands, had long been grossly abused. Individuals, companies, and corporations cut timber pretty much where they liked, and without obtaining title, as the law requires, to the lands cut over. The result was that the Government and State, in a large number of cases, obtained nothing for their forest lands, and the people, the real owners of these lands, did not receive their due. In other numerous cases some payment was made, the timber stripped off, title never completed, and the lands abandoned after being made worthless. Another effect of the system was the encouragement of wasteful and shortsighted methods of lumbering. Whenever the lumbermen did not own the lands over which they were cutting, they very naturally planned their work for to-day only, without regard for the future. Everything in sight at all available was cut, and the waste left so that the fires sure to follow would, with so much material, destroy all seedlings and young trees remaining. No one thought of a scientific forest management, with a view to permanently maintaining our mountain forest lands for forest purposes.

Under the old conditions waste, destruction, and violation of law were rife. Conscientious lumbermen were at a disadvantage, and the abuses spoken of had become so general that few persons considered them improper. The activity of the Board in attempting a reform, and the consequent investigations of the Government, have had a most gratifying result.

The attorney and head of the special service, Mr. E. L. Collins, and the special agents have been active in investigating abuses, and especially in advising and warning interested parties against illegal and improvident practices. As a consequence the lumbering industry is changing its methods. Illegal acts have greatly diminished as their cause has been removed. At this time, practically, all the lumber being cut is upon private land. The change in ownership is shown by the following table:

Name of Office.	Total Number of Timber Entries to May 1, 1888.	Number of Timber Entries since Jan. 1, 1887.
Independence Land Office	90	2
Humboldt Land Office	1,775	220
Los Angeles Land Office	339	198
Marysville Land Office	460	327
Sacramento Land Office	509	116
Shasta Land Office	550	296
San Francisco Land Office	3,100	1,000
Stockton Land Office	305	188
Susanville Land Office	162	84
Visalia Land Office	743	140
Totals	8,033	2,571

It will be seen by this table that the timber entries in the last sixteen months to May 1, 1888, have been about one third in amount of all the timber entries heretofore made in this State. The State school lands in timber have also been very rapidly taken up, and now there are no timber lands of value belonging to the schools in the State.

The School Fund has thus been much benefited, where formerly the lumbering interest paid little or nothing to it, and left the school lands cut over worthless. In the interest of the public schools this Board would respectfully suggest a change in the present law regarding payments for school lands. As the law now stands all payments after the first are at the pleasure of the Legislature.

The management of the forests by the lumbermen, since their increased and general ownership of the timber lands, has greatly improved, and they are in many cases looking to a permanent forest crop from lands formerly considered good for but one cutting.

Our agents have posted fire notices, setting forth the law in regard to the setting of forest fires, throughout the mountains of the State. They have also aided the County District Attorneys in securing evidence against fire setters.

That these agents have done good seems to be conclusively shown by the petitions sent in to reappoint agents, where from lack of funds we had been obliged to discontinue them. These petitions have been signed by merchants, bankers, public officers, and influential citizens. The damage done by forest fires is so considerable every year in this State that agents should be sent out each season to post warning notices with the law against fire-setting, and to show the careless and malicious that some one is looking after such violators of law. We believe that the fires thus prevented have saved the State more money than ten times the whole sum used by the Board.

A very important question for the interests of the State is the protection of the great mountain watersheds, from which the springs and streams used for navigation and for irrigation derive their supplies.

The destruction and extinction of forests upon steep mountain sides has been a frequent occurrence in the history of civilized countries. One certain consequence has invariably flowed from such conduct. Districts so treated have become progressively dry and arid. Springs and streams have diminished in permanent flow of water, or have altogether dried up. Fertility of soil and returns to agriculture have diminished, together with population and wealth. On the other hand, such rains as fall tend to become diluvial in character. The mountain watersheds, deprived of

all means of detaining the rainfall, shed it like a roof, and destructive torrents form, cutting away good lands in one place and covering others with the rough debris of the denuded mountains. The debris of the hydraulic mines in this State is infinitesimal and innocent in its damages to what must occur if the high Sierras are unduly denuded of their forest covering. In such case the rains must flow off more rapidly and the snows melt more suddenly than at present. Thus the perennial value of the streams for irrigation must diminish, and sudden and destructive floods are certain to occur. The history of such countries as Palestine, Persia, Greece, North Africa, Spain, and the south of France demonstrates the results of unwise forest extinction, especially upon mountains. In the single valley of the Durance two hundred thousand acres of fertile valley lands have been covered by the debris and torrents of the denuded watershed of that river. That California will prove no exception to the rule is shown by the instances of the diminution of springs and streams, and the formation of torrents in this State, due to forest destruction, collected and presented with time, place, and witnesses in our last report.

Now that these mountain watersheds in forest, so important to the irrigators, farmers, and consequently to all persons in the State, have generally passed into private hands, there seems but one way left to deal with the question; this way is by education of the people to demonstrate that a wasteful and unscientific destruction of forests upon certain critical points of important watersheds, while temporarily beneficial in a few thousand dollars to some individuals, threatens millions of dollars of property to others. Thus the carelessness or improvidence of one man in the mountains may destroy the property and the means of livelihood of thousands of his fellow citizens in the valleys below. This point established, legislation in the line of the forestry laws of other experienced and civilized countries can be had. We will then have a reasonable regulation of lumbering methods upon important watersheds of the State, with a view of preserving the integrity of our springs and streams for the productive interests of the State. No doubt a cause of action would lay against any one who by such use, even of his own forest property, did damage to his neighbors, either by diminishing their water supply or by so suddenly augmenting it in the form of torrents as to destroy their property. Such remedy will be the State's last resort, and can only be relied on after great damage has been done. Wise measures should prevent such serious injuries to the people.

The active attention of the Board has been given not only to the preservation of our forests, but also to the planting of trees for economic and ornamental purposes. Our native trees have been too much neglected, but with the exception of the Monterey pine they are generally of slow growth, especially in dry situations. The foreign trees introduced have disadvantages in most cases, and that extraordinary grower, the blue gum of Tasmania, is not capable of supporting the frosts of many of our interior points, nor the excessive drought of others. It happens that the very places where trees would be of the greatest advantage are those where the trees usually relied on for planting, will not succeed or do but poorly.

The Board has endeavored to remedy this condition by the introduction of other trees suited to the more difficult climates of the State. After extensive correspondence, the Board felt justified in recommending several trees as being better able to resist excessive drought and to grow with reasonable rapidity than any we had hitherto tried. The trees recommended were the locust, catalpa, eucalyptus viminalis or manna gum, the eucalyptus leucoxylon or blue gum of South Australia, and the eucalyp-

tus corynocalyx or sugar gum. Taking all things into consideration, the last is probably the best. Our recommendations were largely based on the experiments of the Forest Department of South Australia, under the able direction of Mr. J. Ednie Brown. His department had planted a number of stations with trees, in the dry interior of Australia, where the climatic conditions bear a close resemblance to those in the drier portions of our own State. While in these extreme stations the blue gum of Tasmania (E. globulus) did not do well, the other trees named flourished beyond expectation. These trees, and even their seeds, were not to be had in this State. The Board therefore imported seeds from Australia, and distributed them free throughout the State. Many successful plantations are the result.

No tree has been found to grow more rapidly in situations suited to it than the common blue gum. Experiments by a member of the Board show, however, that there are other trees not very inferior in this respect while much more valuable in others qualities. Two trees planted from the pot, six inches high, in the middle of August a year ago, at Santa Monica, nineteen months from the seed and fourteen months from the transplanting, are now, respectively, fourteen feet six and a half inches and fourteen feet six and three quarters inches in height. One of these trees is a eucalyptus corynocalyx (sugar gum), and the tallest a eucalyptus viminalis (manna gum). A tree of the eucalyptus gomphocephala (tooart gum) of the same planting is fourteen feet one inch high. It must be said, however, that the soil and climate at Santa Monica are especially favorable to almost all forest trees. The Board calls attention to a paper in this report by the new head forester, Mr. W. S. Lyon, on the trees found best suited to our different climatic belts in California. We hope in a few years that our experimental stations will enable us to give complete and reliable records as to the availability of any tree to any section of the State.

The great variety of climatic and soil conditions in this State, together with the impossibility of procuring through private means any reliable experimental records as to tree growths in these different belts, has been a handicap to this Board from the first. Correct advice in tree planting could not be given without some record of this kind. Letters requesting the advice and information form a large portion of our correspondence.

To supply this demand the Board decided to establish experimental stations in the different climatic belts of the State, and to make these plantations of trees in such ornamental form as would delight as well as instruct the people. Our plan is to keep an accurate record of temperature, rainfall, etc., and of the growth and condition of each variety of tree planted in each separate station. We had no funds, but the enthusiasm of the officers and the faith of the people have supplied us beyond all expectation with splendid stations. Generous donations of land have been made, and the Board of Forestry now has valuable stations at Santa Monica, Chico, Merced, Hesperia, and San Jacinto, and has promises for two other stations. The largest of these stations is one hundred acres in extent, and the total value of all of them is between seventy-five and one hundred thousand dollars. The nurseries of forest trees already established at the Bidwell station, Chico, and at the Santa Monica station, are estimated to be worth, according to ordinary values, from seven to ten thousand dollars. The Board respectfully submits that such an acquisition of property to the State by deed, shows beyond doubt the growing appreciation of the value of forestry by the people of California, and that the Board has returned three dollars in property to the State for every one it has received in this respect only.

The plan of the Board is to plant these stations in park form, while also having all the trees properly labeled and catalogued, so that the people will be charmed by the beauties of these parks, and at the same time instructed by the information they will give as to the capacities of different trees in our different soils and climates.

Golden Gate Park, in San Francisco, practically without features of instruction, receives more than $100,000 a year, and is of inestimable value to the citizens of that city. The experimental parks of this Board, if properly supported and carried out, will have the same and an additional value to the residents of the State where they are situated. Besides this, they will add greatly to the attractiveness of the State itself. Few places in France are more generally visited than the botanical gardens at Paris; in England, than the gardens at Kew; in Germany, than the Thier Garten, near Berlin, etc.

In these parks scientific tree culture is the main feature. Our experimental stations in California, owing to our climate, can be made both more useful and more attractive than any of them. It seems certainly advisable to show by such State institutions what the different parts of the State are capable of in tree culture. These stations will do this by actual visible experiment to show what will succeed, and by reliable record to show what will not succeed, and thus save time and expense to the citizens, all the time attracting the settler by the beauties demonstrated in the park itself as a capacity of California. From the nurseries already started the Board is distributing forest trees suitable to the State—trees, for the most part, impossible to obtain elsewhere. Such a beautiful and useful tree, and one that does so well in ordinary situations, as the eucalyptus gomphocephala, or tooart gum, can be obtained in quantities nowhere outside of the forestry nurseries. The Torrey pine is another such rare and valuable tree now doing well at the forestry stations.

In our last report we published the first series of our forest map of California. This map was made by actually surveyed section lines, and was absolutely accurate. By it one may know what lands in California have trees or brush on them, what the trees are in each section, and the density of the growth. We have continued this most valuable map, for which we have received so much commendation, and added a new feature. We now represent the principal timber growth in colors. The accompanying report of the engineer of the Board, Mr. H. S. Davidson, will be found of interest and value.

This year the Board has commenced another great work. This is the scientific and popular description of the forest trees of California. Illustrations of the different trees will accompany this report, and enable even an amateur to recognize our native forest trees, and thus add a wonderful interest to all visits to the forest. This year will complete the story of the pine trees of California. This interesting family of trees contains more species in California than are found in any similar area in the world. Amongst them are those bearing the largest cones known, and those bearing the smallest. The largest pine trees of the world are here. Another peculiarity is the extremely small range of some species.

The Board has been fortunate in securing the services of the distinguished botanist, Mr. J. G. Lemmon, and of his accomplished wife for this great work. Properly executed it will make our reports standard books for the forest flora of this State, and give a complete and united description of our trees nowhere else to be found.

The Board in all its work has been obliged to break roads for itself. Forestry work in this State is new. Men willing and capable of taking hold

of it are hard to find, and our laws and social system are different from those of countries where forestry is now practiced. Our climatic and topographical conditions are also unlike those of any locality where scientific forestry is the rule. For these reasons precedents for forestry action in California have no practical existence. The Board has thus been at a disadvantage in its work. Some indulgence therefore should be extended where it has not accomplished as much as it desired and as much as the true forest interests of the State demanded, while on the other hand a fair and reasonable recognition should be given to the important work completed or commenced under such adverse circumstances.

Tree planting for profit or for ornament will add here a value and there a beauty throughout the State, but it is the integrity of the mountain forests, where our streams and springs have their sources, that is vital to the interests of California. The peculiar configuration of the State, with its long, high ranges of mountains parallel to each other, its situation on the Pacific, with a dry and wet season, all combine to make California a locality certain to suffer as much from unwise forest denudation as any country hitherto ruined by such folly. This Board is thoroughly convinced that judicious legislation looking to the preservation of the fertility of the valleys of California by preserving their water supplies should be had. Nothing is of greater moment to the people of this State than an intelligent and firm forest policy. The Forest Commission of the State of New York has more immediate opportunity for doing good, owing to the large State ownership of forest lands and its large annual appropriation, than any other in this country, not even excepting the National Department of Forestry.

Mr. Bernardt E. Fernow, the head of the national forestry work, is a most intelligent and capable man, who has done and is doing much to bring forestry matters before the public with a view of securing Congressional action. Such action is seriously needed at once. Every day's delay makes proper forestry measures more expensive and more difficult. The condition of the nation in regard to forestry may be compared to the story of the Roman republic and the sibylline books. Each time these books of prophecy were offered to the Romans and refused a certain number were destroyed. When they were at length purchased the price was enormous and the books were but a fractional part of what they had been. Thus it will be with forestry, and forestry must come some day.

Good work in forestry has been done in many States. Our results in California we believe will compare favorably with those in any of them. Our report has been extensively quoted, and even so late as this year a whole article has been copied from it. Our report herewith presented will, we believe, be of more permanent value than any official forestry document ever issued anywhere.

The work of the Board has been made possible by the activity and enthusiasm of our officers. We thank them all. The aid and advice offered to us by the national forest officers, by foreign forest officers, especially by the Forest Department of South Australia, and by public spirited citizens, such as Mr. Adolph Sutro, Mr. Joaquin Miller, and others, is highly appreciated, and we extend our hearty thanks to all of them.

The Board has lost since our last report two members by death. Both were distinguished men. Professor A. Kellogg was for many years an eminent scientific worker in the State; an industrious and capable man, he was a loss not only to forestry, but to the State. In Hon. James Bettner the cause of forestry lost a careful business man, intelligent and public spirited on all subjects, and an especial friend of forestry.

The Board has also lost by resignation the first man who took a practical interest in this vital subject, and to whom the State is indebted for the present Board of Forestry. Hon. James V. Coleman found his private affairs so pressing that he was obliged to give up the work that he had so auspiciously started. All connected with the Board have regretted Mr. Coleman's resignation, but we count on his promise to still take a lively, though unofficial, interest in forestry.

The Board recommends that the unsold school lands in brush and forest be reserved from sale and placed under the management of the State Board of Forestry; providing, that all money derived from the sale of timber, pasture privileges, or other sources shall be turned into the State School Fund. It is also recommended that the legislation on forestry suggested by the attorney of this Board be made law.

At the last session of the Legislature a concurrent resolution was passed, praying the National Congress to immediately reserve all Government lands in forest in California from sale, with a view to their permanent preservation as a forest reserve for the protection of the watersheds of the State. This Board earnestly prays that similar action be again taken, and respectfully suggests the further recommendation that henceforth, by the proper laws, it be forbidden to all persons or corporations to cut timber or wood from the public lands for any purpose whatever without a permit from the State or National Forest Officers, as may be deemed most wise.

ABBOT KINNEY, Chairman,
JOHN D. SPRECKELS, Treasurer,
WALTER S. MOORE,
State Board of Forestry.

REPORT OF THE SECRETARY.

SAN FRANCISCO, CAL., November 1, 1888,
Room No. 35, Flood Building.

To the Commissioners of the State Board of Forestry:

GENTLEMEN: I have the honor to submit herewith a report of the business of the office of Secretary for the two years ending November 1, 1888. It is to be regretted that the publication of the proceedings of the Board could not be delayed until the thirty-first of March, 1889, at which date the time of the biennial appropriation will have expired, when a complete statement of the Board's expenditures could have been rendered. The law, however, governing the action of the Commission requires that a report of the Commission shall be presented to his Excellency, the Governor, biennially, and as it is of great importance that this report should also be laid before the State Legislature for consideration, it is imperative that the copy shall be in the hands of the State Printer some weeks before the convening of that body. In consequence of the number and length of the reports awaiting publication, the State Printer should be furnished with copy not later than the first day of November. Hence it is that the financial exhibit herewith presented is only complete as to the transactions between the date at which the last appropriation began to run and the first day of November, 1888.

Since the compilation of the last report of the State Board of Forestry, which was presented to the Legislature convened in January, 1887, death has had much to do with making changes in the personnel of the Commission, and its minutes record the decease of Prof. A. Kellogg and Hon. James Bettner. By the resignation of Hon. J. V. Coleman, the framer of the bill establishing the Board, in fact, we may say, the father of forestry on the Pacific Coast, the Commission also suffered a grievous loss, and forestry matters the earnest workings of one whose heart and soul were thoroughly in the movement. The death of Prof. Kellogg, one of the original members of the Commission, deprived the people of a faithful and conscientious servant and an accomplished scientist. This vacancy was filled by the appointment of Hon. James Bettner, of San Bernardino, who brought to the position the greatest enthusiasm in the cause of forestry and a thorough knowledge of the means to be taken for its advancement. Scarcely, however, had the newly appointed member taken upon himself the duties of his office, barely had he begun to show to the public how earnest and eager he was in the great work of the Commission, when he, too, was called away forever. The vacancy in the Board, caused by the resignation of Mr. Coleman, was filled by the appointment of Hon. John D. Spreckels, and Hon. Walter S. Moore, of Los Angeles, was selected to fill the vacancy caused by the death of Mr. Bettner. These changes, from time to time, necessitated a reëlection of the officers of the Commission, who are at the present writing, Hon. Abbot Kinney, Chairman; Hon. John D. Spreckels, Treasurer.

The Legislature appropriated for the uses of the Board of Forestry for the years 1887–1888 the sum of $29,500, and it was thought at the time

Pinus tuberculata, Gordon.—Knob-Cone Pine, from a water-color sketch by Mrs. J. G. Lemmon.

that this amount would be adequate for the work to be undertaken. The experience of the past two years has shown, however, that the grandeur of the task in hand has been but hinted at, and that the people are but now beginning to awake to the great importance, not only to themselves, but to the coming generations, of tree planting, tree culture, and forest preservation. From many sections of the State offers have been made to donate large and valuable tracts of land to be devoted to experimental tree planting, and it will be readily understood that the care and cultivation of these parks and plantations will entail much greater expenditures than had been foreseen. The appointment of competent officers, forest guards, and the other employés of the Board necessary to the carrying out of the work of tree planting and preservation, will also require increased funds, and what was thought at the inception of this work very ample provision, must in the future be greatly increased if the efficiency of the forest service is to be conserved.

At the first meeting of the Board held after the last appropriation was made, the question of appointing forest guards was taken up and it was then decided to organize a forestry police, with a paid chief and assistants and volunteer aids. It was then stated that in consequence of the condition of the fund at the disposition of the Board, that it would be necessary to limit the number of forest officers under pay, and to rely in great measure on the good will of volunteer officers. It was thought that the surveyors in the different counties of the State would be especially willing and able to help the Board in a part of the work, and accordingly at the suggestion of the United States Surveyor-General, the following circular was drawn up and sent out:

OFFICE OF STATE BOARD OF FORESTRY,
SAN FRANCISCO, —— ——, 1888.

To —— ——, Deputy Surveyor, —— —— County:

SIR: The California State Board of Forestry has been informed by United States Surveyor-General Hammond that the duties of your position are of such a nature as would permit you to act for the State Board as well as the General Government. It is the desire of the State Board to appoint forest officers in each forest district of the State, but insufficiency of funds renders it impossible to pay competent men for their entire time.

It is desired to have reports on the output of timber; the approximate estimate of timber standing; the damage done by pasturage and fire, and the condition of new forest growth, if any, in the different districts. Officers of the State Board have the powers of Sheriffs and Constables in all cases involving the violations of the forestry laws. Among these is one imposing a maximum fine of $1,000 and imprisonment for one year for setting fires in any forest lands. The Board also desires to obtain information as to fraudulent land entries in timber districts, or the stealing of timber on State and school lands. If possible, the Board would like to have a full statement of these cases, together with the names of the witnesses, so as to proceed in law against the culprits. If you can perform these duties please communicate with the Board, stating what country you can cover and on what terms you will agree to perform the service required. If you cannot perform these duties yourself, be kind enough to suggest some reliable person who can do so.

SANDS W. FORMAN, Secretary.

In the majority of cases a favorable answer was received to this appeal, and when the party addressed was unable to accept, or rather to tender his services, he was kind enough to suggest some reliable person who was willing to act in his place. In this way the Board succeeded in securing the services of a competent and economical corps of sub-agents in thirty-three counties in the State. Their aid in distributing the fire notices throughout the timber counties, in reporting cases of depredation on State school land or preventing the same, has been most invaluable. In addition to these sub-agents, great assistance was rendered the Board by the officials of the Southern Pacific Railroad Company, who sent to each station master in the State copies of the fire notices, stating the penalty for

starting timber and brush fires, with the directions that the same be posted in a conspicuous place about the depot. And in order that no section of the State might by any chance be overlooked, the Board caused to be prepared and sent out the following circular to the Postmasters of the State:

OFFICE OF STATE BOARD OF FORESTRY,
SAN FRANCISCO, —— ——, 188—.

To the Postmaster of —— ——:

We inclose you two copies of a fire notice prepared by this Board, one of which we would be glad to have you place in a prominent position in your Post Office; the second is to replace the first, should it be torn down or destroyed.

All good citizens are interested in the preservation of our forests and the stopping of the annually wasteful fires that do so much damage throughout the State. We therefore hope for your coöperation in this matter.

ABBOT KINNEY,
Chairman State Board of Forestry.

When the Board had at last satisfied itself that it had secured the services of a reliable and energetic corps of sub-agents it issued a circular of instructions, at the same time sending out over twenty thousand of the canvas fire notices, which are believed to have found their way into every timber township in the State. The instructions to sub-agents read as follows:

OFFICE OF STATE BOARD OF FORESTRY,
SAN FRANCISCO, —— ——, 188—.

Mr. —— ——:

DEAR SIR: You have been appointed a Special Agent of the State Board of Forestry, for the purpose of coöperating with us in the protection of our timber lands. It is necessary to preserve these forests, primarily for future generations. As a large portion of our State is dependent on irrigation for its productiveness, it is also important that our watersheds be adequately protected. This can only be done by a complete reservation of all timber lands among which our mountain streams have their origin.

It is a well established fact that when mountains are denuded of their timber, the springs and streams soon dry up. The rains then descend on the bare mountain sides, passing off as destructive torrents, productive of only injury, instead of good.

It is, therefore, necessary that proper steps be taken to preserve our forests from destruction. In order to accomplish this, we must gain reliable information concerning depredations on our public timber lands. The law does not permit timber to be cut on State or Government lands, unless the same has been entirely paid for. This prohibition, however, does not apply to wood or timber cut for domestic purposes. If you are aware of any illegal cutting of timber in your vicinity, we should like to have you notify us of such, giving the number of the section and township in which it has occurred; also the names of persons responsible for the cutting, together with the names of any witnesses who will testify to the facts in the case. If possible, state approximately the amount of wood or timber cut, and its probable value.

We wish especially to guard against forest fires, and should you ascertain the existence of any, we desire you to learn, if possible, the names of the persons who originated them. We also desire to learn the names of such witnesses as will prove material in a legal prosecution.

Your attention is called to Section 1 of an Act passed by our last Legislature, and approved March 7, 1887, providing for an increase in the powers of the State Board of Forestry:

"All the members of the State Board of Forestry of this State, and all assistants now employed, or hereafter to be employed by said Board, are hereby endowed with all the powers of police officers, for the purpose of making arrests for any violation of any law applying to forests or brush lands within this State, or prohibiting the destruction thereof."

You will observe that by the provisions of this statute, you are clothed with the authority to make arrests whenever you personally witness the illegal cutting of timber on State lands, or the willful setting of any forest fire. In such a case, it would be your duty to turn the offender over to a Constable, and swear to a complaint before a Justice of the Peace for that district in which the offense was committed. If it should appear, from your report to us, that a serious violation of the law has taken place, we will send an agent to your locality for the purpose of making further investigation. When, however, you can gain information concerning any extensive destruction to timber lands, especially forest fires, we shall expect you to improve the opportunity. When possible, we should like to have the statements of witnesses taken in writing, and sworn to by them before a Notary Public.

Should you at any time receive notices to post throughout your county, you will place them in conspicuous places in the leading towns and along county roads.

As to compensation for work performed, we have decided to allow four dollars per day. The amount of funds at the disposal of the Board for this kind of work is very limited. We cannot afford to pay regular salaries, but only for such time as is actually consumed in performing the work desired. Under no circumstances will we approve extravagant claims, and in all cases we must be satisfied that the work has been done as represented.

In presenting to us a bill for services rendered, we shall require a detailed statement of the work performed each day, including time and place. If engaged in posting bills, state the number of bills posted each day, on what roads, and the approximate distance traveled. You must also make an affidavit as to these statements, before a Notary Public, using a blank demand, which we will furnish on application to this office.

Hoping that you will prove of service to us in our efforts to protect the forests of this State, we remain,

Very truly yours,

ABBOT KINNEY, Chairman.

THE EXPERIMENTAL STATIONS.

At the meeting of the Board held July 1, 1887, it was decided to establish an experimental station for tree planting at Santa Monica, for the purpose of ascertaining the comparative value of trees in the interior and along the coast, and at the meeting of the nineteenth of July the following resolutions were adopted:

Resolved, That the State Board of Forestry will receive proposals for the use of tracts of land in the southern, central, and northern sections of the State, to be devoted to experimental tree planting, the said tracts to be placed under the absolute control of the said Board for a term of years hereafter to be agreed upon.

Resolved, That the Board will also receive proposals for the care and cultivation of the said tracts, which are to be laid out and arranged after the manner of parks and public grounds, and to be used for the recreation and instruction of the people at large, under specifications that will be prepared, copies of which may be had on application to the Secretary of the Board.

On the twentieth of December, 1887, the Santa Monica tract, designed for experimental tree planting, was formally accepted, and H. Rowland Lee placed in charge as Head Forester.

At the meeting of the Board held July 20, 1887, H. S. Davidson was appointed Engineer of the Board to complete the forest map of the State commenced by Hubert Vischer, Esq.

At the meeting of the Board held the following day the annexed circulars were drawn up, and the Secretary instructed to send them out at once. That they were productive of immense good, and the means of saving much valuable property, cannot be questioned. They were as follows:

TO LUMBERMEN AND MILLMEN.

OFFICE OF STATE BOARD OF FORESTRY,
SAN FRANCISCO, —— ——, 188—.

To —— ——:

DEAR SIR: The importance of the lumber industry is fully realized by the State Board of Forestry. To those engaged in this industry the importance of maintaining a continuous supply of lumber by means of renewed growths must be equally evident. Under the present land laws the honest and legitimate lumber dealer is in continuous competition with the robber and perjurer, who is now so extensively despoiling the Government and State school lands. The land laws are such that strict compliance with them by lumbermen is almost impossible. Owing to the total absence of official supervision destructive fires spread from one district to another to the great injury of the lumber interests, both present and prospective. We should be glad to have your views on this subject, and especially as to our plan. This is, that all of the timber land in the State should now be withdrawn from sale or entry, and the lumber interest provided for by the European system of the sale of the timber alone, leaving the title to the land in the Government, with the responsibility of establishing a new growth as fast as timber is cut. Thus the mountain sides, springs, and streams will be protected, a perennial supply of timber and fuel be maintained, and the necessity of violation of the law in the lumber industry be done away with. Please give us your views.

TO COUNTY BOARDS OF TRADE.

OFFICE OF STATE BOARD OF FORESTRY,
SAN FRANCISCO, —— ——, 188—.

To the honorable Board of Trade, —— ——:

GENTLEMEN: The State Board of Forestry invites you to coöperate with them in their efforts to preserve the timber lands from the waste now prevailing. The depredations of timber thieves, the ravages by fires started sometimes inadvertently by campers or sheep-herders, and often designedly by the latter for the purpose of creating new pasture land, or other reasons; the browsing of sheep upon the tender shoots of young trees, are among the principal evils causing wasteful depletion of the timber resources of the State, and operating to prevent renewal by the efforts of nature. It will be the effort of this Board to put a stop to all unlawful actions operating to the detriment of the State in regard to its timber lands. The many evils that will surely flow from the denudation of our mountains have been repeatedly pointed out. The results upon our irrigation, farming, and navigation interests can easily be predicted from past experience in other countries. They can be but deplorable. The Board is advised that much public timber land is being taken up, by entry or otherwise, by dummies in the interest of speculators, who propose to strip the land ruthlessly, and then abandon it. We ask your assistance to aid us in putting a stop to this practice, and to use your influence in every way to check the waste we have alluded to from other causes. The Board proposes to establish experimental stations in different parts of the State, where, under their supervision, forest trees from other countries will be planted and tested as to their usefulness and adaptability to our soil and climate. It is thought by the Board that such stations might be made attractive and instructive, and that their establishment in any locality will be a benefit to it. We have invited proposals for donations of land to the Board to be used for the purpose indicated, and invite your consideration and support of the project in your locality.

TO COUNTY SHERIFFS.

OFFICE OF STATE BOARD OF FORESTRY,
SAN FRANCISCO, —— ——, 188—.

To the Sheriff, —— —— *County, Cal.:*

SIR: The loss of property in the State caused by fire is very great. In the forests destructive fires are now allowed to go unchecked, except occasionally when private interests demand protection. From this cause, as well as owing to the extensive illegal cutting of timber from Government and State school land, the denudation and waste in our forests is great. Thus the property of the public and of the school children is dissipated, the sources of the streams and springs injured, floods alternate with drought, and the whole irrigation interests of the State suffer. The State Board of Forestry desire to alter these conditions, and among its measures is one to form a forestry police. The duties of these officials will be to report fires set in the forests, with all possible evidence, so that we may proceed in law against such violators, and also to report all trespasses and robbery upon the State school lands—section sixteen and thirty-six in each township—and upon the Government land, with the names of witnesses, etc. Our funds will not permit us to pay for the whole time of competent men, but we should be glad to pay liberally for actual work done as indicated. Please send us the name of a reliable man who would act for us in these matters. We thought some deputy in your office, at times when his duties permitted, might undertake such work

At the meeting of the Board held July 22, 1887, Edward L. Collins was appointed Special Agent of the Board, to collect evidence in cases of depredations on Government and State school land, and to prosecute all violators of the forestry laws. On the twenty-seventh of January, 1888, at the regular meeting of the Board, Mr. A. C. Hibbard appeared in behalf of ex-Governor John C. Bidwell, and invited the Commissioners to visit and inspect a tract of land near Chico, in Butte County, some thirty-seven acres in extent, which would be tendered by its owner, Governor Bidwell, to be used by the Board for an experimental tree planting station. Some days later Commissioners Kinney and Spreckels proceeded to the land in question, and a few weeks after the transfer of deeds was made to the Commission, and a force of men set to work to lay out and improve the new park.

On the thirtieth of April, 1888, the Board met, and removed H. Rowland Lee from the position of Head Forester, and appointed in his place Thos. H. Douglas. At the same meeting the appointment of Professor J. G. Lemmon as Botanist for the Board was confirmed.

The officers of the Board, especially the Botanist and Engineer, prosecuted their work with great diligence during the summer months of the year 1888, for it will be readily understood that it would have been impossible to go into the higher altitudes and the extreme northern counties to continue their researches during the winter, and from time to time sent in reports of the progress they were making. At the meeting of the twenty-fifth of July, on motion of Commissioner Moore, the Botanist, the Engineer, the Special Agent, and the Head Forester were notified that they were expected to present to the Board, at the meeting to be held October fifteenth, a brief outline of the reports which they were to prepare for publication and intended for presentation to his Excellency the Governor and the State Legislature. When the Board met on the date last named it was found that in order to provide for the publication of the reports, the making of the maps, the illustrating of the report of the Botanist, for the keeping up the work at the experimental stations, and the other necessary expenses of the Commission, it would be necessary to suspend, for a time, the work being performed by certain officers, thus cutting down the pay-roll to the lowest figure consistent with properly conducting the business of the Board. Accordingly the services of the Botanist, the Engineer, and the Special Agent were dispensed with after November first. Mr. William S. Lyon was appointed at this meeting to succeed Mr. Thos. H. Douglas as Head Forester. The officers who were suspended have but fairly entered on their most important labors, and it is hoped that the State Legislature will see the great necessity of providing such an appropriation as will be amply sufficient to enable the Board to continue their services, so that they may bring their work to a successful termination.

TREE PLANTING BULLETINS.

During the year now closing the Board of Forestry have issued the following tree planting bulletins:

FORESTRY BULLETIN, No. 1.

TREE PLANTING.

The encouragement of tree planting by tree seed distribution was the first temporary expedient adopted for that purpose by the California State Board of Forestry. We are to-day organized for what we hope will prove a practical and permanent plan for economic tree planting in California.

We have now two experimental forest stations established; one at Santa Monica, and the other the Bidwell Station, at Chico. In these two stations we have now more than one hundred and fifty thousand seedling forest trees, which will be ready for planting next season.

We have three other stations promised us, and expect to have experimental grounds planted as a park, for both beauty and instruction, in every climatic belt in California.

When any one desires to plant forest trees extensively, we will send the Head Forester to inspect the land and advise as to the kind to plant, the preparation of the soil, and the care of the trees after planting.

To prevent favoritism, and with a view to making the Forest Board eventually self-sustaining, we will charge for the time and expenses of the forest officers when thus engaged. We will also be able to furnish the rarer varieties of trees not grown in quantities by nurseries. Our object will be to encourage and make practical forest tree planting (now in a very unsatisfactory condition), and to help nurserymen, rather than to compete with them, by advice founded on the scientific observations our experimental stations will enable us to make. We also intend to try the experiment of planting out, for a fair remuneration, a few tree culture land claims, to see whether the Federal Land Act may not be made of some benefit to forestry, at least in California. As a part of this bulletin, we add suggestions in reference to planting forest seeds and forest trees, by T. H. Douglas, Head Forester.

The Board in its efforts to encourage tree planting by accurate information and the aid of a practical tree planter, will not lose sight of the fact that the one great object of Forestry in California is to preserve the brush and tree-covered mountain watersheds of the

State, and to manage the existing forests scientifically, so that these may supply fuel and lumber, and yet retain their reproductive power and general forest integrity.

ABBOT KINNEY,
JOHN D. SPRECKELS,
WALTER S. MOORE,
Commissioners of Forestry.

CARE OF SEEDLING TREES.

When forest tree seedlings packed closely as they usually must be, are received from a distance, they should be taken out of the boxes without loss of time. Unpack the boxes in the shade; prepare a puddle of rich soil mixed with water to about the consistency of paint; dip each bundle of trees so that all the roots will be coated with the puddle. If evergreen trees, the puddle must not be allowed to come in contact with the foliage.

If planting can be commenced within a day or two, the bundles of trees may be placed standing with the roots on moist ground in the shed or cellar and packing material placed around them. If not ready to plant in a day or two, the trees should be laid in a trench, standing, and in thin layers, with earth pressed firmly over the roots of each layer, in a cool, shady place, with a few branches of trees or straw over the tops. This is called by nurserymen, heeling in. Trees in boxes as transplanted from seed beds, of course, do not need this treatment.

Land to be planted with forest trees should be prepared as well as for a farm crop. The roots of the trees should be kept moist and not exposed to the air while being planted. Plant them a little deeper than they stood in the nursery, and press the earth firmly with the foot over the roots of each tree when planted. Keep the soil loose and free from weeds until the trees shade the ground and prevent the weeds growing.

T. H. DOUGLAS,
Head Forester.

ASH.

The white, blue, and all other kinds of ash seed, except the green, should be mixed with moist sand as soon as gathered, and placed in a cool place until time to sow in the spring. A slight frost will not hurt them if not allowed to "freeze dry."

The green ash seed can be kept dry, but it is a good plan to soak it in water a few days before sowing. Cover all from one quarter to one half inch.

AILANTHUS

Can be kept dry and sown late in the spring when the ground gets warmer. Cover about one fourth inch.

ACACIA AND PSEUDACACIA

Can be kept dry, but should be soaked in *warm* water before sowing, as the shell is very hard, and some of it will not come the first year if not well soaked.

NEGUNDO (BOX ELDER)

Is much better kept the same as white ash, but can be kept dry; in which case soak it thoroughly before sowing.

CATALPA.

Catalpa seed is kept dry and should not be sown until the ground gets thoroughly warm, as it is apt to rot in cold, wet soil; cover about half an inch.

ELM.

Elm seeds ripen in the spring, and should be gathered and sown at once; cover lightly.

EUCALYPTUS.

Eucalyptus seeds of all kinds should be kept dry. They are very easy to start, if not covered too deeply.

MAPLE.

Hard or sugar maple ripens its seeds in the fall, and should be mixed with moist earth. But a small per cent will grow if kept dry. At the best there is not over 50 per cent of it perfect seed. Cover not to exceed one half inch.

Soft maple (white) and red maple ripen their seeds in the spring, and should be sown at once. Do not leave them, nor elm seeds, in boxes or baskets long, as they are liable to heat and spoil; have known them to spoil from lying in a box two days. Cover the same as hard maple.

NUTS.

All nuts with a pulpy covering should be put in a rot heap, *i. e.*, a layer of nuts two or three inches deep, then a layer of earth the same thickness, then nuts, and so on. The whole wet down; freezing will not be injurious. In the case of acorns, chestnuts, etc., they should be fixed with sand and kept in a *cool place*.

PINES

Can be sown dry, and will need a protection such as lath frames or brush. They can be sown broadcast and raked in very lightly.

SPRUCE, FIRS, CYPRESS, ETC.,

Need the same treatment as pines. Junipers are very slow to germinate, sometimes requiring two or more years to generate. They should be put in a rot heap. All of the conifers are slow growers the first year.

Forestry Bulletin, No. 2.

The nursery at the State Board of Forestry Station, at Santa Monica, is now ready to furnish rare trees for experiment, in small or in large quantities. The lowness of our appropriation, together with the desire of the Board to show no favoritism to any one, have induced us to charge the cost of rearing and boxing upon all trees. Besides this preliminary list, we have ready or nearly ready for distribution a large number of native trees. The experimental stations at Chico, Hesperia, and San Jacinto will soon offer information as to what trees do best in our different climatic belts, and will thus give a basis upon which persons interested may make large plantations of trees on waste lands for fuel, lumber, or the arts.

Persons desiring trees will please address Abbot Kinney, Chairman State Board of Forestry, Santa Monica, California.

	er doz.	Per 100.
Acacia melanoxylon	25 cts.	$4 00
Acacia decurrens (Australian wattle)	25 cts.	4 00
Acacia pycnantha (broad leaf wattle)	25 cts.	4 00
Ailanthus glandulosus	25 cts.	3 00
Acer macrophyllum (maple)	25 cts.	4 00
Acer negundo	25 cts.	3 00
Catalpa speciosa, 2 to 3 ft. tp.	25 cts.	4 00
Catalpa speciosa, 1 to 2 ft.	......	1 50
Eucalyptus corynocalyx (sugar gum)	25 cts.	4 00
Eucalyptus eugenioides (noble gum)	25 cts.	4 00
Eucalyptus gomphocephala (tooart gum)	25 cts.	4 00
Eucalyptus obliqua (stringy bark)	25 cts.	4 00
Eucalyptus polyanthema (poplar leaved gum)	25 cts.	4 00
Eucalyptus rostrata (red gum)	25 cts.	3 00
Eucalyptus viminalis (manna gum)	25 cts.	4 00
All other eucalyptus, 50 cts. per dozen.		
Robinia pseudacacia (locust)	25 cts.	3 00
Schinus molle, 18 to 34 in. (pepper tree)	25 cts.	4 00

List No. 1. Price, $5.

Eucalyptus polyanthema	20 plants.
Eucalyptus viminalis (manna gum)	20 plants.
Eucalyptus leucoxylon (blue gum of South Australia)	10 plants.
Eucalyptus doratoxylon	5 plants.
Eucalyptus corymbosa	5 plants.
Eucalyptus colophylla (red gum of West Australia)	5 plants.
Eucalyptus obliqua (stringy bark)	10 plants.
Eucalyptus eugenioides (noble gum)	5 plants.
Eucalyptus marginata (jarrah)	5 plants.
Eucalyptus globulus (Tasmanian or common blue gum)	5 plants.
Eucalyptus hemiphloia (box)	3 plants.
Eucalyptus paniculata	3 plants.
Eucalyptus luehmanni	4 plants.
	100 plants.

In case we are out of any of the above, we reserve the right to replace them with other kinds equally rare and valuable.

List No. 2. Price, $5.

Eucalyptus gomphocephala (tooart gum)	20 plants.
Eucalyptus rostrata (red gum)	20 plants.
Eucalyptus corynocalyx (sugar gum)	10 plants.
Eucalyptus stuartiana	5 plants.
Eucalyptus robusta	5 plants.
Eucalyptus amygdalina (giant or messmate gum)	5 plants.
Eucalyptus pilularis (black butt)	5 plants.
Eucalyptus platypus	5 plants.
Eucalyptus rudis	5 plants.
Eucalyptus cornuta	5 plants.
Eucalyptus capilellata	5 plants.
Eucalyptus planchonsiana	5 plants.
Eucalyptus platypus (variety purpurens)	5 plants.
	100 plants.

We reserve the same rights as in No. 1.

List No. 3. Price, $1.

Eucalyptus polyanthema	4 plants.
Eucalyptus viminalis	4 plants.
Eucalyptus leucoxylon	4 plants.

List No. 4. Price, $1.

Eucalyptus gomphocephala	4 plants.
Eucalyptus obliqua	4 plants.
Eucalyptus rostrata	4 plants.

The following at $1 per box—16 plants, of one variety:

Eucalyptus polyanthema.
Eucalyptus viminalis.
Eucalyptus leucoxylon.
Eucalyptus obliqua.
Eucalyptus gomphocephala.
Eucalyptus rostrata.

FORESTRY BULLETIN NO. 3.

LIST OF TREES AND PRICES AT SANTA MONICA EXPERIMENTAL STATION.

	Per Doz.	Per 100.
Acacia melanoxylon, transplanted	50 cts.	$4 00
Acacia decurrens, transplanted	50 cts.	4 00
Acacia pycnantha, transplanted	50 cts.	4 00
Ailanthus glandulosus	50 cts.	3 00
Acer macrophyllum, transplanted	50 cts.	4 00
Acer negundo	50 cts.	3 00
Catalpa speciosa, 3 to 4 feet, transplanted	50 cts.	4 00
Catalpa speciosa, 2 to 3 feet, transplanted	------	2 00
Eucalyptus corynocalyx (sugar gum), transplanted	50 cts.	4 00
Eucalyptus eugenoides, transplanted	50 cts.	4 00
Eucalyptus gomphocephela (tooart), transplanted	50 cts.	4 00
Eucalyptus obliqua, transplanted	50 cts.	4 00
Eucalyptus polyanthema, transplanted	50 cts.	4 00
Eucalyptus rostrata (common red gum), transplanted	50 cts.	3 00
Eucalyptus viminalis (manna gum), transplanted	50 cts.	4 00
Eucalyptus leucoxylon (blue gum of Australia), transplanted	50 cts.	4 00
Eucalyptus globulus (blue gum of Tasmania), transplanted	------	3 00
Robinia pseudacacia (locust), 18 to 30 inches	50 cts.	3 00
Schinus molle (pepper)	50 cts.	6 00

The following varieties of eucalyptus are now ready to be delivered at the Santa Monica express office, or railroad station, in boxes of one hundred (100) plants, at four dollars ($4) per box:

Eucalyptus amygdalina (giant tree of Australia).
Eucalyptus leucoxylon (blue gum of Australia).
Eucalyptus corynocalyx (sugar gum, fine tree).
Eucalyptus globulus (blue gum of Tasmania).
Eucalyptus gomphocephela (tooart gum, fine tree).
Eucalyptus marginata.
Eucalyptus obliqua.
Eucalyptus eugenioides.

Eucalyptus polyanthema.
Eucalyptus viminalis (manna gum, fine tree).
Eucalyptus rostrata (common red gum).
Sixteen trees in a box for one dollar ($1).
Eucalyptus calyophylla (red gum of West Australia, large, handsome flowers).
Eucalyptus paniculata.
Eucalyptus stuartiana.
Eucalyptus hemiophloia.
Eucalyptus robusta.

Address— ABBOT KINNEY,
Chairman State Board of Forestry, at Santa Monica, California.

TREE SEED DISTRIBUTION.

During the years 1887–88 there was sent out by the Board over $600 worth of tree seeds, and on every package was printed a request to the effect that the party planting the seed would note its growth and progress, and report the same from time to time to the Commission. Not many answers up to the present writing have been received, probably owing in most cases to the comparatively short time that has elapsed since the seeds were planted, but those thus far received have been decidedly satisfactory.

The following may serve as a sample:

COLONY OLIVENHAIN, October 9, 1888.

To the State Board of Forestry:

GENTLEMEN: May I ask your favor in sending some seeds for myself and a few friends, mostly eucalyptus and gold wattle. Two years ago I wrote to the Hon. Abbot Kinney and got seed from the gentleman. For one year I carried the water which was necessary for the trees a quarter of a mile, but must say to a great extent I am rewarded. I have some two hundred gum and gold wattle growing, some of the blue gum having a height of ten to twelve feet; and so has a neighbor of mine, Mr. David Geiger. Some of the other neighbors, who neglected it two years ago, would like to try again, as I have proven by what success I have had that the trees can be grown.

By sending some eucalyptus corynocalyx, eucalyptus globulus, and red gum, you could indeed oblige us very much. I intend to plant a little forest of my own; besides, the trees are a good windbreak.

Most respectfully, yours truly,
JOHN ETZELSTORFER.

P. S.—Please send a little gold wattle seed too; and, if you have anything new, let me try it. J. E.

REPORTS OF SUB-AGENTS.

The corps of sub-agents, who are distributed through the thirty-five timber counties of the State, are unanimous in their opinion that the generous posting of the fire notices during the past two years has had a most salutary effect, and saved to the State untold thousands of dollars' worth of valuable timber. From San Diego County the sub-agent sends the following:

SAN DIEGO COUNTY.

SAN DIEGO, CALIFORNIA, November 5, 1888.

To the State Board of Forestry:

GENTLEMEN: I have posted fire notices in the different parts of the county that I have traveled through for the past eighteen months—along the following roads, and in most of the valleys near to them: Julian, Stonewall, Descanso, Alpine, Lawson Valley, Lyons Valley, Jamul, Dubzura, and Campo. I consider they have had a very good effect, as in districts where considerable timber had been cut on Government land, there is not any being destroyed in that manner at the present time.

They have also had the effect of making settlers more careful in setting fire to brush but great improvements in this direction might be made.

The only districts I know of where much timber is being cut are near the Julian and Stonewall Mines, and that is being used for mining purposes.

Oak timber grows at a distance of from twenty-five to thirty miles from the coast, at an elevation of about one thousand feet. The varieties consists of black oak, white oak, and live oak. Pine timber grows at a distance of about fifty to sixty miles from the coast, at an elevation of three thousand five hundred to four thousand feet, some of it being of very large growth. Timber grows in considerable quantities in most of the valleys and on the sides of some of the mountains.

The water supply in the mountains is adequate for all purposes. The Cuyamaca and Sweetwater Dams are doing much towards supplying the wants of land owners near the coast, and are thus utilizing a large quantity of water which has heretofore gone to waste.

FOREST FIRES.

At least one third of the land covered with brush, grass, and oak timber in the southern part of this county has been burnt off by settlers within the past eighteen months, doing a great deal of damage, not only as regards pasturage, timber, and bees, but also decreasing the reservoirs of water, which the absence of brush will effect, to a certain extent, the same as timber. These fires are caused by careless settlers, who at the time only intend to burn a few acres of brush, but everything being very dry at the time the fire soon gets out of their control, and the result is the fire takes everything before it. I have seen these fires spread five miles square in a few days. It is impossible to convict these parties without they are caught in the act. I would suggest that each year, from the month of July to the month of November, a special officer be paid to look up these cases, and, by making an example of one or two incendiaries, soon stop this great evil. Settlers find out after a little experience that after setting fire to the brush it is harder to grub, as they have not the limbs to pull by, and it is also very disagreeable to handle on account of the charcoal being on the short limbs, so that nothing is really gained by setting fire to the brush.

VINEYARDS.

More grapes are grown in El Cajon Valley than in all the other valleys in San Diego County. These grapes are grown without irrigation, and seem to do very well.

It is hard to obtain any accurate statistics of the number of acres planted in vines at the present time in San Diego County, but from what I can obtain from a published account, there are about 1,200 acres of wine grapes, 7,000 acres of raisin grapes, and 500 acres of table grapes.

The vineyards containing more than one hundred acres in El Cajon Valley are:

Johnson & Marshall, 800 acres; A. Hart, 200 acres; Souther & Crosby, 585 acres; A. K. Holt, 150 acres; Geo. A. Cowles estate, 400 acres; Levi Chase, 130 acres; H. P. McKoon, 300 acres; W. Peel, 120 acres.

There are a great many more vineyards in the valley of forty acres and less. Some very fine raisin grapes are also grown at Alpine.

A very large acreage of fruit trees of nearly every variety has been planted in different parts of the county.

TIMBER CULTURE CLAIMS.

Quite a number of timber culture claims have been filed on in this county within the past three years. Several were filed on for speculation, and a great many have been contested on account of there already being timber on the claim or in the section. Why are not some of these parties prosecuted for perjury? A few settlers are complying with the law to the best of their ability, but it will be impossible for many of them to have the required number of trees growing at the end of the eight years.

The law requires that at the time of final proof:

First—That not less than two thousand seven hundred trees, of the proper character, were planted on each acre required to be planted.

Second—That the quantity and character of trees as aforesaid have been cultivated and protected for not less than eight years preceding the time of making proof.

Third—That at the time of making proof there are growing at least six hundred and seventy-five living and thrifty trees to each acre.

Now two thousand seven hundred trees to the acre means planting them four feet apart, and of course we know that is too close for almost any trees to be planted, and what is the use of planting them for the sake of putting them in the ground, not only for 75 per cent to die, but to impoverish and stunt the growth of those that live. We would have more healthy trees at twenty feet apart. Even six hundred and seventy-five trees, the quantity required to the acre, living and thrifty at the time of proving up, is entirely too many to the acre.

If the law were revised so that a settler might plant the trees anywhere to do the most good, and so that he had a certain number of living, thrifty trees to every forty acres of his claim, give him his patent. In this way a settler might plant trees around his house, barn, or boundary line, in fact, anywhere to do the most good.

Respectfully,

FRED. E. LEWIS,

United States Deputy Mineral Surveyor, Special Agent State Board of Forestry.

PLUMAS COUNTY.

To the honorable State Board of Forestry:

GENTLEMEN: I somewhat regret the circumstances that make it necessary for me to furnish the Board a report *prematurely*. When I received your letter of the twenty-third of October, my commission, issued on the fifteenth of October, had been in my hands only five days. I cheerfully furnish you a report, though so meager have been my opportunities, and so limited the time, since my authorization to act in the interest of the Board, that the report must of necessity be very incomplete, and will be confined exclusively to Plumas County, through portions of which only I have moved.

THE VASTNESS AND THE GRANDEUR OF HER TIMBER WEALTH.

The computed area of the nine counties lying chiefly beyond the foothill limits, and making up one half, less or more, of the timber area of the State, viz.: Sierra, Plumas, Lassen, Modoc, Siskiyou, Del Norte, Trinity, Shasta, and Tehama, is fourteen million five hundred and seventy-four thousand acres. And, making allowances for the nude surface above the snow line and on the summits of the watersheds, and for desert parts and parts covered by lava and chaparral, as well as for agricultural and dairy lands, it is safe to estimate that at least two thirds of the above area, or nine million seven hundred and sixteen thousand acres, is well timbered woodland. Of the fourteen million five hundred and seventy-four thousand acres in the nine most northern counties, Plumas covers one million five hundred and eleven thousand and forty acres; and deducting for agricultural and grazing lands and barren mountain lands, and for portions partially denuded of timber by the sawyers, there remain in the county at least one million two hundred and fifty thousand acres of heavily timbered land. The dense and heavy tracts of timber are numerous; so that it is rather difficult to intelligently locate them. There are two prominently heavy belts of timber in opposite extremes of the county. The one, and perhaps the densest, is located in the west and northwest part of the county, and sweeps in solid phalanx of giant conifers from the Big Meadows up the broad watershed of Mount Lassen, and from Prattville away to the west and southwest toward the summit overlooking the Sacramento Valley, and thence again away to the south toward Butte Valley and Dutch Hill, down the North Fork of the Feather River and its tributaries, covering all of the vast drainage slopes over which Mount Lassen stands sentry. The other belt is in the east and southeast portion of the county, beginning about Spring Garden Ranch, ten miles east of Quincy, the county seat, and extending several leagues toward Beckwith, and up and down the East Branch of Feather River and its tributaries.

No more valuable and unbroken bodies of sugar pine, yellow pine, spruce, fir, cedar, abietine, etc., can be found in the State. And, though a lumber mill has been put in, here and there, at wide intervals, these magnificent forests are practically intact. There are ten saws in operation in the county, with a daily capacity of one hundred thousand feet, or an annual output of eighteen million feet of lumber, at an average run of six months in the year. Most of the mills are operated by water power, and are of small capacity, there being not more than half the amount of lumber cut since the decadence of the hydraulic mining that there was previously. The mills are adjacent to the farming and mining districts, and supply only the local demand, there being but one mill that ships out lumber, and that is on the highway between Quincy and Oroville, the latter place being the point of egress for their lumber. The two principal timber areas of the county are on the lines of two principal passes and waterways, over which two prospective railways will soon find access to this immense wealth of forestry now useless to the State, and, to a considerable extent, falling under wastage and other destroying influences. Above forty thousand acres of the finest timber land of the county is owned by the Sierra Flume and Lumber Company. May it to no greater extent fall into the rapacious hands of corporate power. It is not in the power of figures to estimate the value to the State of her forestry wealth, through the private citizen who shall possess it and transform it into the tangible prosperity of the commonwealth.

DESTRUCTION OF THE GOVERNMENT TIMBER.

Respecting forest fires, I have to report that they have, during the past summer, and up to the present time, been rather numerous in this quarter of the State, and some of them quite extensive in area, doing much damage. Around Big Meadows, Indian and American Valleys, and elsewhere in the county, fires have raged at intervals during the summer; and, though the damage is not very serious in any one locality, yet in the aggregate it is calamitous. Two summers ago, a forest fire occurred in the Cherokee Mining District, near Greenville, that consumed a $5,000 quartz mill. Two of the most extensive and destructive fires in the timber adjacent to Indian Valley were the result of lightning, one of the causes of fire on the timber domain. Other causes are, presumably, the carelessness of hunters and stockmen and, inferentially, the work of some of the sheep men who desire better pasturage on the burnt districts the following season.

As to watershed and drainage slopes, they are unaltered and will so continue while the forest remains unbroken or not greatly changed.

Respecting depredations on the public lands, I have not the least doubt that there are not a few infractions of the law in this regard; but as yet I have no means of getting at the facts. The appointment of *forestry wardens* would do much to deter offenders.

SOME LEGISLATION

Is needed respecting greater vigilance and a more zealous care of our forestry domain. We would suggest that some action, State or National, be had looking to the appointment of forestry wardens over the timber domain of the State. I have not called them fire wardens, because their duties should be more comprehensive. When fires break out on the public lands they should have the authority to employ men to extinguish them at the public expense. It frequently happens on the occurrence of forest fires that the laboring classes are so occupied with their industrial pursuits that they have not the time to remain at the scene of the fire, after a partial extinguishment, long enough to completely subdue it. In such instances there should be some power to command the services of unoccupied men to put out the fire in its incipiency, and to remain at the scene of the conflagration until it is completely controlled.

It should be the business of the wardens also to be on the alert for the causes of fires, and to endeavor to bring to punishment any who carelessly or otherwise set fires; and to post themselves in respect to the boundaries of the different timber claimants, so as to see that none trespass upon the public lands. This forestry wardenship might be added to the duties of the Boards of Supervisors of the respective counties, and a reasonable compensation be allowed to all who thus subserve the public good in the protection of the forestry interests, to be paid out of any fund available in the premises, the General Government indemnifying the State for any expense incurred in preserving United States property.

County Boards of Supervisors have been suggested in this connection, because the members of them are well distributed over the county, thus affording a fair opportunity of timely detecting fires or any depredations on the public domain; and because, also, they are supposed to be alive to every interest of their respective counties.

In conclusion, it seems to me that, from the exceeding meagerness of our information on the locality, extent, and nature of our valuable forestry interests and products, there is need of an active canvassing *forester*, as energetic and wideawake as the very gazelles of these primitive woods, to give accurate information of the locality and extent of the different grades of timber in the State, with the number and the names of all the varieties of trees growing in the State, and in what particular section to be found; to determine, approximately, the entire timber area of the State, the number of saws operated, and their annual output in lumber, with the consequent rate of denudation in a year, how, and what for; the rate of restoration in a year by tree planting; and to collect forestry products, materials, and information of value to the department.

I have visited the prominent schools of the county, and have endeavored to interest them in the execution of graphic representations of the forestry products of their respective regions, and there are quite a number of sketches in drawings and paintings forthcoming from the schools.

Yours very truly and respectfully,

G. D. HINES,
Special Agent California State Board of Forestry.

IRVINGTON, CALIFORNIA, October 31, 1888.

CALAVERAS COUNTY.

SAN ANDREAS, November 4, 1888.

To the State Board of Forestry:

GENTLEMEN: In answer to your circular letter, I will state that I have very little to report.

There has been no extensive fires in the timber belt this season. The number of notices posted did not exceed twelve. I am uncertain as to how much effect they had upon the setting of fires. Certain it is that there has not been so many as usual. There have been about four fires, which did considerable damage to limited localities in destroying mining ditch flumes, and in one case burned up about two thousand cords of wood, but they were soon mastered and extinguished. The most of our fires are chargeable to accident while men are out hunting, and carelessness in lighting pipes and dropping fire in the dry grass.

I know of no depredations upon the public lands and the timber belt, except what has been going on for years—I allude to the destruction of sugar pine. In traveling through the timber belt, large numbers of fine sugar pine trees are found cut down and lying on the ground to rot. Some of them have only one cut of three feet in length sawed out, and the balance left. In other cases, a fourth or a third of the tree is worked up for shakes and the rest left.

It seems that the system is to cut down a tree, and then saw out a cut; if this cut cannot be split and rived into shakes, the tree is considered worthless, and left to rot. It seems that these men cannot tell beforehand, to a certainty, whether the tree will rive or not. They can only tell by trial.

How this waste is to be remedied is a question.

The shake-makers are a class of poor men, generally trying to make a living, and to stop them from their work looks hard—since all over the country we see men of wealth who have been in the lumbering business and have undoubtedly trespassed heretofore to a greater or less extent upon the public lands. To discriminate against them would seem

to be like favoring the rich and oppressing the poor. Yet, it seems to me, that this thing should be stopped some way.

Yours respectfully,

A. H. COULTER,
Special Agent State Board of Forestry.

SAN BERNARDINO COUNTY.

San Bernardino, October 31, 1888.

To the State Board of Forestry:

Gentlemen: Your favor at hand. I would say to the State Board of Forestry that I have done all in my power to keep down fires, and I have succeeded in keeping sheep off of the most of the State and Government land in and about Bear Valley, one of the finest timbered and watered districts in the mountains, by placing friends of mine on timber claims in various places through the mountains, so that sheep could not get in without infringing on their claims, and by so doing have kept the mountains almost free of fires, as the sheep men are the cause of nine tenths of the fires in the mountains.

During the summer I have posted about fifty fire notices throughout my district, and as there has not been a fire this summer and fall that has done any damage, I judge by this that the fire notices have done the business. I watched very close this fall to try and catch some party setting out fires, to make an example of, but I could not do it, as there was none set out. Last fall a year ago the mountains were afire in every direction, which shows that the work has done some good.

Hoping that the above will be satisfactory,

Yours truly,

GUS. KNIGHT, Jr.,
Special Agent State Board of Forestry.

TUOLUMNE COUNTY.

Sonora, Tuolumne County, November 5, 1888.

To the State Board of Forestry:

Gentlemen: I have made during the year two trips, as far east in Tuolumne County as Baker Station, which is situated on the north bank of Main Fork of the Tuolumne River, and about nine miles from the summit.

I traveled on the Sonora and Mono wagon road, which runs through the principal timber cutting region of the county. I find that the shake-makers, since the notices were posted, have abandoned the business of cutting timber on public land. Early in the spring I was notified that two men were about to begin cutting timber on unsurveyed land near Strawberry. I warned them that if they did they would be prosecuted, and they desisted. In fact, shakes for the last year have been scarce and dear. The sawmills, of which we have three in the county, cut timber on the lands owned by them. All the notices sent me by the office have been posted to the best advantage over the county.

This has been the driest season for many years. The rivers are very low, and many springs have dried that always flowed since the settlement of the county. For two years the rainfall has been very light. I have a theory that the denudation of the forests of the State is only a minor cause of the scarcity of water in the earth. At the time of the first settlement of the State, the earth was as porous as a sponge, and retained the water. I have seen the time in early days when a wagon could not be driven out of a beaten road, and when it was dangerous to ride a horse off a well traveled trail. The thousands of animals that have roamed over the country for the last thirty-nine years, the travel of men and wagons, and other causes of like nature, have hardened and settled the surface of the ground and the water runs off without penetrating. There can be no doubt that sheep are a curse to the State; they penetrate everywhere, destroy the roots and seeds of the grasses, in traveling over the hills they keep the rocks and earth moving, destroying vegetation and denuding the hills of their soil, and are the cause of more fires than anything else.

Respectfully,

J. P. DART,
Special Agent State Board of Forestry.

HUMBOLDT COUNTY.

Garberville, Humboldt County, October 11, 1888.

To the State Board of Forestry:

Gentlemen: I have lately been over considerable of the ground, on which I posted fire notices, in the South Fork Township. That part lying west of the South Fork of Eel River is more heavily timbered than the balance, and quite a number of notices were posted through this portion. I find about one third of these have been torn down, and it might be advisable to post more before the first of June next.

From my acquaintance with the people and their habits, I believe these notices were generally destroyed by parties who have been the cause of the fires that have burned yearly for a long time; yet they were read by many, before they were torn down, and have done much good, for this summer there has been no smoke in the country, while other years there has been much smoke from fires burning in the woods, and from which more or less good timber fell.

From my own knowledge, and from inquiries made of parties living in different sections, I may say that there has been less fire this summer than for many years, and it has been unusually favorable for fires, having been hot and dry. It is now so late in the season that there is but little danger before another spring.

There was a fire in the northern part of Mendocino County that burned through some whitethorn thickets, and some large timber fell. This fire was on Government land, and I have been told that it was set out purposely.

During the last few years thousands of tanbark oak trees have been cut along the coast, in the southern part of this county and northern part of Mendocino County. The bark of every available tree over six or eight inches in diameter has been used. The bodies of these trees are now lying in every direction among the standing timber, which is composed of white, black, and live oak, fir, madrona, redwood, etc. It is almost certain that in the near future fire will run through these fallen trees, and greater damage than usual will be done to the standing timber. I think there is some tanbark timber occasionally cut on Government land by parties owning bark land adjoining, they claiming not to know where their lines are. The only way to know this positively would be to run lines by a surveyor; or, if the violations of law were flagrant, any good woodman could tell by going over the ground. I have heard parties that work in the woods say they thought tanbark was sometimes cut on Government land, and these men usually are correct in their opinion.

Very respectfully,

C. B. FROST,
Special Agent State Board of Forestry.

The reports of the Special Agents given above, are the more important ones received at the main office, though others were sent in which contained matter not sufficiently valuable to warrant publication. In every instance, however, the opinion was expressed that the posting of the fire notices and the publicity given to the reward for illegal cutting of timber on State and Government land had been productive of a great saving to the people.

THE MECHANICS FAIR EXHIBIT.

At the meeting of the Board held July 25, 1888, on motion of Hon. John D. Spreckels, it was decided to make an exhibit of cones, barks, and specimens of California woods at the Mechanics Fair, to be held in San Francisco during the months of August and September. It was thought that such an exhibition could do much to attract increased attention to the subject of forestry, and Professor Lemmon and his wife were appointed to take charge of the display. It is believed that the exhibit had a most satisfactory effect, as great interest was evinced in it by the many thousands who visited the Fair.

In conclusion I beg leave to present a statement of the expenditures of the Board of Forestry from March 31, 1887, to November 1, 1888:

FINANCIAL STATEMENT.

Appropriation, 1887-1888		$29,500 00
Salary of Botanist	$1,200 00	
Incidental expenses of Botanist	154 00	
Salary of Engineer	2,250 00	
Traveling expenses of Engineer	964 40	
Salary of Secretary	2,375 00	
Incidental expenses of Secretary	157 70	
Salary of Head Forester	1,332 50	
Traveling expenses, etc., of Head Forester	365 30	
Salary of Special Agent	1,145 00	
Traveling expenses of Special Agent	966 30	
Salary of detective	320 00	
Incidental and traveling expenses of detective	160 10	
Salary of clerk at Santa Monica	400 00	
Traveling and incidental expenses of Commissioners	1,327 37	
Salary of Forestry agents, posting notices, etc.	571 50	
Expenses of Experimental Stations	7,426 52	
Seeds, trees, etc., distributed	627 07	
Stationery, porter, postage, printing, etc., main office	473 57	
Office rent, furniture, fuel, etc., main office	600 57	
Legal expenses	75 00	
Expenses of Forestry exhibit in Mechanics Fair, San Francisco	177 35	
		23,069 25
Balance to credit of Board		$6,430 75

It should be borne in mind that five months are yet to intervene between the date of the above statement and the expiration of the time in which the last appropriation has to run. The balance to the credit of the Board, it is thought, will barely suffice to pay the necessary expenses of the Board, the care and cultivation of the plantations already set out and growing, the expense of illustrating by plates and maps the present report, the sending of the same through the mails, the traveling expenses of the Commissioners and officers, and the necessary incidental expenses of the main office.

Respectfully,

SANDS W. FORMAN,
Secretary.

November 1, 1888.

No. 2.—*Pinus Lambertiana*, Dougl.—Sugar Pine, near Mt. Shasta. Alt. 5,000 feet.

SUGGESTIONS

FOR

Forest Planting in California, by Wm. S. Lyon, Head Forester.

SUGGESTIONS FOR FOREST PLANTING IN CALIFORNIA.

PART I.

In an empire so vast as California, embracing every conceivable variety of known soil, from alluvial sedimentary deposits of inexhaustible depth and fertility to sterile and almost denuded mountain sides, containing at most shallow pockets of partly disintegrated shale and porphyry, and exhibiting within its boundaries a surprising range of meteorological conditions, comprising nearly all variations, from the continuous dew point to almost perfect atmospheric hydration, and with a rainfall varying from fifty inches to practically nothing, it can hardly be expected that explicit rules and directions governing the planting and future care of young forests can be indicated, which will exactly apply to all points and localities within an area exhibiting such diverse conditions. Hence, only such general suggestions to those intending to plant forests are here outlined, as well as the treatment of an exhaustive subject will admit of embodying within the limits of a brief memoir.

We may assume that for many years to come, forest planting will largely be confined to "waste" lands—not necessarily valueless tracts, but to such as are not considered arable; such as low mountains, steep foothills, cañons, or even the great sandy or bowlder-filled washes which are salient features throughout the length of the State. This assumption is not based on any hypothesis that it will not pay to devote the cream of our farming lands to this purpose. No such concession is implied, as considerable acreage of our choicest lands has been long enough planted in locust, eucalyptus, or even the despised willow, to yield better returns than the same land will produce in cereals. The drawback to owners of small holdings from utilizing their best lands for this purpose must ever be the time elapsing before they can realize a crop—three to four years for willows, four to six years for gums, and six to eight for locusts. For the privilege of cutting such forest fifty dollars per acre in the first case, two hundred in the second, and two hundred and fifty for fencing posts in the last has been paid in different parts of the State where fuel or timber is scarce.

As the first crop is the only one requiring specific outlay of time and money, subsequent crops are only chargeable with taxes on the land and interest on the investment.

Some hundreds of acres of the best quality of "corn land" near Compton, Los Angeles County, are thus maintained in willows that pay on this basis 15 per cent per annum on a valuation of $100 per acre. In the case of blue gums 50 per cent per annum income has been returned on this valuation.

As an industry, the planting of quick-growing forest has not been widely enough undertaken in this State to definitely fix the profits arising therefrom. The abundance or scarcity of native forest or brush land, the distance from a market, the price of coal or petroleum, are all factors which must regulate the profits and the practicability in each instance.

Indirectly, it in all cases pays. In our great interior valleys, forests not only furnish a supply of domestic fuel and timber, but are of inestimable

value for the shelter they afford growing crops against burning, drying winds.

On foothill and mountain lands their value as conservators of our water supply is too well known to require demonstration. Quick-growing forest trees are of doubtful value except planted and cared for as a crop.

In moist soil and with a little culture the blue gum will in five to six years produce a timber of sixty to seventy feet, and one and one half to two feet diameter at the ground.

The same tree, mountain planted, without care or cultivation, will, at the end of that period, be still a mere sapling.. Hence, for "waste land" planting, I would commend trees of slower growth, slower returns, but ultimately of highest value as timber producers. Various species and system of planting are suggested later.

Foremost among rapid-growing trees for our arable or irrigable valley lands is, of course, the blue gum. Sensitive to light frosts when young, it will, when aged, withstand a temperature of 16 degrees Fahrenheit. The planting in any part of the State where 24 degrees is touched every winter is, however, attended with risk, as that temperature is quite sufficient to destroy a young plantation.

Eucalyptus rostrata and eucalyptus paniculata are much more enduring of cold, young trees of both having at Lancaster, California, withstood a temperature of 12 degrees Fahrenheit during winter of 1887-88.

Both will doubtless thrive in all our interior valleys south of Sacramento, where the blue gum has proven to be non-resistant of their normal winter weather; of slower growth, but with the claim made for both of producing more valuable timber than the blue gum.

During the coming winter the cold resistant power of many species of gums heretofore untried in California will be thoroughly tested.

In planting gums or any quick-growing timber, the ground should be thoroughly prepared and the trees set out in rows six feet apart and the trees six feet distant in the rows.

The object of systematic planting is twofold. First, where this character of the land will admit, to enable the planter for one season to give careful, painstaking cultivation. Thereafter subsequent tillage will be needless. The normal growth of the young plantation should so shade the ground that weeds will not molest them. Secondly, close planting will induce a tall, straight growth, resulting in a spar, or timber free from knots or lateral growth.

After taking the first cutting, gums will sprout or "break" from near the ground, showing a bushy habit, but the original close planting again comes in play and a leader soon outstrips the other, and in a year or two the smaller growths will be shaded and die off, subsequently leaving a second cutting in character similar to the first.

Gums make their most vigorous growth during hot weather, hence winter or spring planting should be deferred until the ground is warm. Land kept mellow by winter cultivation will retain sufficient moisture to insure a good growth, although where summer irrigation be practical, phenomenal results may be attained.

Of trees of proximately rapid growth, requiring sufficiently good soil and enough moisture to be classed among those suitable for valley planting, we cite the locusts and catalpa as flourishing through the length and breadth of the State, standing all our extremes of climate, and of superior value for railroad ties and fencing. Both are freely grown from seed, the former only requiring a thorough soaking to facilitate sprouting. One

year of generous tilth in nursery produces a tree available for immediate forest planting.

A moderately rapid tree is the native California walnut; it is adapted to nearly all soils and situations (not alkaline) and has a range from Sacramento south and east through the State into Arizona, New Mexico, and Sonora. In rough mountains a mere shrub, it makes in good soil a tree of forty to fifty feet, and, though lacking the commercial value of the eastern black walnut, its worth as a tree of general adaptability must bring it to the front.

It should be transplanted at one year. The expense attendant transplanting of larger trees without injury to the taproot is inadequate to the benefits desired, except in small plantations. Only two native and one exotic conifers are recommended for planting on moist, arable lands.

The common Monterey pine is one, and that commendation solely with a view to its rapid production of forest, as the tree is only of medium size (sixty to eighty feet), and the lumber is of inferior quality. Still, it is unique among conifers, making in five years the growth that most species require fifteen to accomplish. It is easily grown from seed by an amateur, and should be handled and transplanted at our coldest season, as at that time it makes the bulk of its annual growth. Thriving naturally in a limited area, it has transplanted kindly to the southern end of the State, and its speedy growth has given it prominence to the exclusion of more valuable timber trees.

The exotic referred to (casuarina equisitacæfolia) has given good results wherever planted in the southern counties, but thrives best on moist lands.

The third and last conifer (unfortunately of slower growth) is the only one of the three of sufficient timber value to justify the surrender of irrigable lands of the best quality to its perpetual endowment. This is the "white cedar" of Oregon (chamæcyparis lawsoniana, or Lawson cypress).

It ranges from Shasta County north, but only in moist lands. Its perfect adaptability to all climatic conditions in all parts of our State has been conclusively proven, but abundance of irrigation for its full development is an absolute *sine qua non* to success. Its confessed and peerless beauty among our native conifers is, of course, a secondary consideration, but as a timber tree it stands preeminent, unapproached by the many fine timber trees peculiar to the west coast.

The wood is white, fragrant, and elastic, close and fine grained, and extremely durable, and, as it reaches a height of one hundred and twenty to one hundred and fifty feet, it furnishes the finest of material for spars and masts.

In Northern California it should be widely planted; in the southern and central part only, as previously stated, where facilities for continuous irrigation prevail.

Requiring two and three years' growth in nursery to make an available tree for planting out, enhances its first cost, and is consequently a drawback to extended planting.

On uplands, mesas, or even rolling foothills, particularly on such as are porous, gravelly, or even somewhat stony, without water facilities, and hence of minimum value for general agriculture, we would reject the quick-growing forest as ill adapted to produce full development of the tree, and consequently yield inadequate returns; for planting on such we suggest even as slow growers as the oaks.

Vast tracts of land of this character extend for many miles through our interior valleys entirely destitute of any vestige of trees, and although the wood of all our native oaks, with the possible exception of quercus garryana,

are, from their brash, brittle nature, of most doubtful value for timber, yet for fuel purposes they are unexceptionable—in fact, among the best.

Amongst many species the deciduous Q. lobata and the "live oak," Q. chrysolepis, will best fulfill all requirements and all conditions on all lands as above described.

The live oak attains its finest development in the north central part of the State, the deciduous, in the southern portion; yet both species have the widest possible range from Tehama to San Diego County.

Being of wide-spreading habit—sixty to eighty feet diameter of head—no close planting is admissible or desirable. Fifteen feet apart each way, with a view to cutting out one half in a few years for fuel, and the subsequent removal of still another half, would leave room for the ultimate full development of the forest.

Q. garryana has the widest range of all the oaks, extending from British Columbia quite into our southeastern desert; but it naturally seeks better soils than the other species, and though its wide distribution enhances its worth, it is questionable if any slow growing tree not of assured timber value, can be profitably grown on high priced lands.

We can add that all these oaks are scattered throughout the mountains of California to considerable altitudes, but generally they become scrubby and depauperate.

Of trees that we know will thrive under analogous conditions with the oaks, but of smaller growth, are the California horse chestnut, in the north and central parts, and one species of manzanita (arctostaphylos pungenis) in the south.

Both are only of fuel value, but self-supporting after the first year of planting. The former is easily grown from seed; the latter is of difficult and tedious germination.

For planting the numerous "washes" which indent our mountain ranges for their entire length, and which not infrequently develop into considerable expanse of waste land, nothing is more suitable than the maple and the sycamore. In any of these washes which, higher in the mountains, carry a water supply, the seepage in the dry parts will furnish enough water to assure success. Where the wash was only the outlet of a winter watershed, some water might be of advantage the first season.

Our California sycamore, though better than its eastern congener, is only noted as a variety—an alternative. It is of secondary value for both fuel and lumber. The California maple, however, is a timber tree of the very highest economic value. It is readily recognized by its very large leaf, light gray bark, and having its young branches green, with stripes of lighter or reddish color. The wood is white, very hard, and takes a high polish. For cabinet, or fine interior work, it is superior to the eastern white maple. It makes a tree of fifty to ninety feet, and stem of two to three feet in diameter, and stretches from San Diego County to the extreme northern boundary of the State.

Although, as stated, it grows in absolutely dry washes, its size steadily increases as we move north, which shows it is not unresponsive to increased rainfall.

Maples multiply freely and easily from seed, and one season in nursery fits it for permanent planting. In such of these washes which have water—even if it be largely withdrawn for irrigation—farther up them enough moisture and subterranean flow exists to nourish a great number of species.

In these places the California laurel and Oregon ash will indisputably thrive. Both are of easy propagation, fairly good growth, and of supreme commercial value in the arts. Both attain their highest development about

Douglas County, Oregon, and diminish a little in size at the extreme southern line of California. Still, the Oregon ash at the south develops to a tree, whilst the more southern ash (fraxinus dipetela) rarely exceeds a shrub of fifteen to twenty feet.

For planting on the arid and almost rainless desert lands in the southeast quarter of the State, we must have recourse chiefly to the mesquite. Even with irrigation, it is problematical if our best timber trees can there withstand the dryness of the atmosphere.

An exception may exist in some of the exotic acacias, as one native species (A. greggi) makes a tree of fifteen to twenty feet in some of the most forbidding parts of the territory. For fuel purposes the mesquite is rated higher than the oak, and has with few exceptions a more extended habitat than any known tree. It runs through Southern California eastward to Texas, and south through Mexico; thence into South America along the Andes into Chili; thence eastward once more across the continent into Buenos Ayres.

With such a range it might be safely attempted in Central California. The seed pods of this species are fed largely to horses, and quite an industry exists in Texas and Mexico in gathering its gum for export and adulteration with the gum arabic of commerce.

The pod of a smaller species (prosopis pubescens) is also ground into meal and used for food by both whites and Indians.

That the mesquite will respond to generous treatment is proven by seeing them in cultivation not infrequently as trees of thirty to forty feet, and on the desert sometimes a straggling shrub of five to ten feet.

Mesquite seed is most readily sprouted, and plantations should be made close, for though of spreading habit like the oaks, the branches are often spinescent, and like any other objectionable growth, can be crowded out and eliminated by close planting.

Along our southern seaboard we have for many miles long reaches of barren sea wastes; in some localities, as immediately south of Santa Monica, Los Angeles County, a substratum of good soil is overlaid with sand heaped up by the winds into fantastic dunes.

This character (with occasional rifts) extends throughout the coast line of Ventura, Los Angeles, and San Diego Counties. North of Point Concepcion the bolder conformity of the coast and approximation of the mountains to the sea, causes this phenomenon to disappear. Wherever it occurs the planting of rhus integrifolia and Torreys pine can be resorted to with absolute certainty of success and without further care than the original planting.

The pine will make a tree of twenty to thirty feet, and, though becoming more or less deformed by the trade winds, serves to make an effective wind break and to utilize lands wholly worthless for general agriculture. It matters not how deep the overlying sand, it will grow in every instance.

Too much praise cannot be accorded the rhus; it makes a dense, dwarf, evergreen hedge of the neatest and most compact habit, of uniform growth, and thrives down almost to the high-water line.

As an underground mine its greatest riches occur. Small bushes—two to three feet—commonly bear roots three to five feet long and six to eight inches thick, which carry but few fibers, and hence are easily dug out and removed from the yielding sands.

The wood is a dark cherry-red and useful in cabinet work, as well as forming an excellent fuel. Other species of rhus approach the coast, but none combine both usefulness and beauty in so marked a degree.

On the northern coast, sandy spits and bars are not only frequently invaded by conifers, but usually the adjacent country is sufficiently well supplied with fuel to make their specific planting unprofitable.

The distribution and treatment of coniferous trees for mountain planting will form the subject-matter of a subsequent memoir.

WM. S. LYON,
Head Forester.

No. 4.—*Pinus albicaulis*, Engelm.—White-Bark Pine. On the timber line of Mt. Shasta. Alt. 9,000 feet.

REPORT

OF THE

Former Head Forester, Thos. H. Douglas.

4[31]

REPORT OF HEAD FORESTER.

It is idle to talk of our natural forests furnishing a supply of wood for the future use of our people. Even with the most careful management and economy in regard to waste, there must soon come a great scarcity of all kinds of wood. Even now over one half of the accessible timber of the State has been cut. Flumes and railways have been constructed into the heart of the heaviest forests in the State. Especially is this the case with the redwood (sequoia sempervirens), sugar pine (pinus lambertiana), Oregon pine (pseudotsuga douglasii), and yellow pine (pinus ponderosa) forests. No matter in what way we turn, the fact stares us in the face that the best and most valuable forests on the coast—in other words, the finest timber in the world—are fast disappearing, and the sooner we begin to spare the young timber, and economize in the use of woods of all kinds, and preserve the forests now standing, as well as commence planting new ones, the better it will be for the present and future generations. The people of this State must awake to the matter sooner or later. There are now more acres of timber destroyed by fires, set by careless persons, than are planted. California has been classed as a timber State, but such is not the fact, as two thirds of what has not been already cut is inaccessible.

The States east of the Rocky Mountains have awakened to the necessity of keeping what forests they have, and are planting thousands of acres annually. Nebraska alone plants in the neighborhood of one hundred and fifty thousand acres annually; Kansas, Iowa, and Dakota nearly if not quite as many each; while in this State thousands of acres of land are lying idle that could be growing timber. Where brush will grow trees will grow, and it is one of the objects of the experimental stations of this Board to find out what kinds do best in certain localities. This is a greater undertaking than one at first might imagine, as the climate and soil vary so greatly in this State; marked differences being noticeable in places even within a few miles of each other. For instance, the eucalyptus globulus and acacias do well on the coast in San Diego County; three miles inland they make very little growth, and run out entirely five miles from the coast. The catalpa speciosa and robinia pseudacacia (the yellow locust of the East) here take their place and do remarkably well; but it would not be advisable to plant the latter where the citrus fruit will thrive, as they, like the true acacias, breed the cottony cushion scale. Both the catalpa and locust will stand very cold weather; they are both natives of southern Ohio, Indiana, and Illinois, and are perfectly hardy several hundred miles north. The Southern Pacific Railroad planted a great many catalpas along their lines in this State, but unfortunately they planted the catalpa bignioides, a variety much inferior to the speciosa.

We have over thirty kinds of eucalyptus at the Santa Monica experimental nursery ready for this season's planting, and are in hopes some of them will grow on the sandy barrens of the southern part of the State without irrigation. I have no doubt but that the mesquite (prosopis juliflora), ironwood (olneya tesota), paloverde (park insonia torryana), and desert willow (chilopsis saligna), all natives of New Mexico and Arizona will do well on any of the barren, sandy soils of Los Angeles, San Bernar-

dino, and San Diego Counties. I have known them to stand uninjured 24 degrees of frost (8 degrees Fahrenheit) in Arizona. The mesquite is very good for bees also, as it is in flower nearly all the year, but the heaviest bloom is in May and June. The desert willow is also in bloom nearly the whole year, but as there were no bees where I saw it growing I do not know how it answers for that purpose.

In forest planting the first thing to do, of course, is to get the ground in shape. It will not merely do to cut the brush off and plant the trees, but break it and have it in as good condition as you would for barley or other farm crop; if possible raise a crop on it before setting out the trees, in order to have it perfectly clean. Mark out as you would for corn. Do not mix your trees if possible, as the strongest growers when young will smother and kill out the slower growers, which may be the most valuable kind when grown properly. If planting in groups, select kinds that are known to do well together. Do not plant trees that have soft, spongy roots on very hard, heavy soil, especially when they have to send their roots through hardpan or stiff clay for water. The softness of the root denotes their habitat, which is either a light loam or sandy soil. Keep the ground well cultivated until the trees shade the soil so weeds will not grow. The eucalyptus family are about the only Australian forest trees that are not troubled with the scale, but as there are so many varieties of it planters must be careful to get a large growing kind, as some of them are merely shrubs. The following are all valuable forest trees:

Eucalyptus haemeostema—white gum. Good fuel. Height, fifty to one hundred feet.

Eucalyptus tereticornis—gray or red gum. Inferior fuel. Durable in the ground. One hundred and fifty feet.

Eucalyptus siderophroia—dark or broad-leaved ironbark. The most valuable wood for piles, girders, etc. Superior fuel for steam engines. One hundred and fifty feet.

Eucalyptus paniculata—common ironbark. For most purposes equal to the last. More easily split. One hundred and fifty feet.

E. obliqua—stringbark. The best for flooring and sawn stuff. Inferior fuel. One hundred and twenty feet.

E. pilularis—blackbutt. Wood similar to above. One hundred and fifty to two hundred feet.

E. hemiophloia—common box. Hard, strong, tough, and durable above ground, but not lasting in contact with the earth. One hundred and fifty feet.

E. amygdalina—messmate or almond-leaved stringbark. A first class timber for flooring, etc. Inferior fuel. One hundred and fifty to two hundred feet.

E. bicolor—black box, ironbark box. A highly valued timber tree. Wood easily worked. One hundred to one hundred and fifty feet.

E. corymbosa—bloodwood. Durable as posts, piles, etc. Not a good fuel. One hundred and fifty to two hundred feet.

E. calophylla. Valuable for its timber and for ornament.

E. marginata—jarrah. A very excellent timber, and suitable for dry barren soils and severe climates.

E. globulus—Tasmanian blue gum. This tree is too well known to describe its useful qualities.

The above are all good timber trees and ought to be more generally distributed through the State, the southern part especially. The E. polyanthema is reported to do well also on dry gravelly soil, and furnishes durable timber; it bears transplanting better than most of the eucalyptus, and has certainly thrived well at the Santa Monica Station in soil too poor for other kinds. The great drawback to planting the eucalyptus is, most of them require considerable water and are very tender, a very few degrees of frost killing them to the ground; very few survived last winter's cold snap in the Sacramento Valley. I would not advise planting them where the redwood or "big tree," sequoia sempervirens and S. gigantea, will grow. The latter certainly do well in the San Gabriel Valley in the south, and Sacramento in the north.

It is a great pity that these and other valuable California trees, such as pinus ponderosa, P. sabiniana, chaemicyparis lawsoniani, pseudotsuga douglasii, libocedrus decurrens, acer macrophyllum, the larger growing oaks and other deciduous trees, have not been more generally planted, as they are very rapid growers and the timber when grown is of more use than the Australian trees. The ailanthus glandulosus is a rapid growing tree, furnishing excellent timber, but on account of the odor of the male flowers should not be planted near dwellings. The pinus torreyana, that rare and sturdy pine found growing in San Diego County, only near the coast, will, no doubt, do well many degrees farther north along the coast. It is not large enough for a forest tree, but will, no doubt, be found serviceable near the coast as a windbreak and to keep the sands from drifting. The Monterey pine (P. insignis) and Monterey cypress (C. macrocarpa) are also good for this purpose and adapt themselves to a great variety of soils. The Oregon ash (fraxinus oregona) and the Arizona ash (F. pestæcifolia) will, no doubt, do well in this State. I have seen the Arizona ash one year old that was from five to seven feet high. The Kentucky coffee tree (gynonocladus canadensis) is reported to do well wherever planted in this State, but from experience with it on the other side of the mountains I consider it a very slow grower.

What the State needs is rapid-growing trees, and they to be planted in forest form. A group or collection of trees will often grow and do well where a single tree of the same variety would die. In the former case they shade the ground more effectually, and each one helps to break the wind from the others. A great many people are under the erroneous idea that extensive planting of trees causes more rainfall, but such is not the case, as records and observations show. People point to the "plains" of Kansas and Nebraska, and say that before planting the thousands of acres of forest which has been done there, the ground was so dry that nothing would grow. Records show that there has not been a material change in the rainfall there during the past forty years; but, thanks to the plowed lands, which absorb all the rain that falls upon them (it all ran off before the plowing), and the forests already planted, which absorb all that falls among them, and by shading the ground retard evaporation, besides breaking the force of the winds, thereby rendering the air more humid, making it possible for plants and trees to grow there now, that the hot, drying winds of a quarter of a century ago would have dried up in a few hours.

THOS. H. DOUGLAS,
Former Head Forester.

REPORT

OF THE

SPECIAL AGENT, E. L. COLLINS.

No. 5.—*Pinus Balfouriana*, Jeff.—Fox-tail Pine, south flank of Mount Eddy, near Shasta. Alt. 7,000 feet.

REPORT OF THE SPECIAL AGENT.

San Francisco, October 31, 1888.

To the State Board of Forestry:

Gentlemen: On the twenty-third day of July, 1887, I received from this Board an appointment as Special Agent. My instructions were to investigate all cases of alleged timber cutting and forest fires, and whenever good and reliable evidence could be secured against depredators, to prosecute them in Court. With this end in view, I have endeavored with the limited means at my command, to lessen the amount of forest destruction, taking such measures as seemed necessary to call the attention of the public to the statutes on this subject, and filing complaints against offenders of the law whenever circumstances seemed to justify it.

Up to the time that I received my commission, but little, if any, attempt had been made to enforce such laws as were designed to prevent depredations on timber lands. The prevalence of forest fires and indiscriminate destruction of timber on Government and State lands were rapidly diminishing in area and value our magnificent forest resources. Reckless and extravagant waste characterized the work of our lumber mills; open and unrestrained theft of wood and tanbark was carried on throughout the entire State. The forests were regarded as common property, open to depredation without question, against which no law had as yet been directed. To correct such a general and false impression was indeed no easy task; to successfully prosecute a case of timber depredation before a jury of men holding such views was still more difficult.

Such was the character of the work upon which my labors were thenceforth directed, to combat the customs and usages of long years, and inaugurate and carry out a line of policy different from what had heretofore existed.

At this time it was known to the Board that several large lumber companies had for many years been unlawfully removing timber from State school lands. As the Forestry Commission had been established for the purpose of guarding the forests of this State, it certainly seemed as if State lands were the rightful objects of its protection.

In order to make a test case of the matter, I was instructed to proceed to Mariposa County for the purpose of collecting evidence against Jno. R. Hite and Jno. W. Snyder, proprietors of the only lumber mill then in existence in that county. These persons, we had been informed, had removed timber from a certain unentered school section of land.

A few months prior to this time, the United States authorities had sent two special timber agents to this State, whose duty was to investigate all timber depredations occurring on Government lands. As our authority did not extend over these lands, our Board welcomed the arrival of this assistance as exceedingly opportune for the general advancement of forestry work on this coast. Mr. R. W. Anderson, one of the agents just referred to, had shortly before my visit to Mariposa completed an investigation into the illegal cutting of timber on Government land by the same firm of Hite & Snyder. The result of this investigation was the filing of a civil suit by the United States against these persons for the sum of nearly $100,000, said amount being damages sought for the destruction of timber.

My own investigation concerning this same case resulted in an accumulation of the most complete evidence against Messrs. Hite & Snyder, as to the illegal cutting of some four hundred thousand feet of lumber on school land. This evidence was then referred to Attorney-General Johnson. After a careful examination of the statutes bearing on the subject, the Attorney-General informed us that, in his judgment, the Board possessed no authority to prosecute civil suits against timber depredators. This decision was unexpected, and defeated our hopes of recovering heavy damages from several lumber companies, against whom we undoubtedly had strong cases. In consequence of the above decision, the work of the Board has been greatly cramped. Denied the right to protect Government timber lands, unauthorized to recover damages for trespass on school lands, there remained to us but one remedy at law for timber depredations and fire setting, namely: the right to bring a criminal action against the offender. Unfortunately, the statute of limitations barred the right after the lapse of one year from the commission of the offense. Thus, at the very commencement of our work, the Board found itself handicapped on all sides. However, the mission of such a body is partly to ascertain just where the laws are inadequate and defective, and then endeavor to remedy the same through proper legislation at Sacramento.

This matter I have ever kept in view since my appointment. During this time I have personally investigated cases of alleged timber cutting and fire setting in the Counties of Napa, Sonoma, San Mateo, Santa Clara, Santa Cruz, Mariposa, Fresno, Santa Barbara, Ventura, Los Angeles, San Bernardino, and San Diego. Whenever evidence was obtained sufficiently strong to warrant a prosecution, the action was invariably commenced. Aside from the above work, I have attended to the appointment of local special agents, arranged for the distribution and posting of fire notices throughout the mountain regions, and carried on an extensive correspondence concerning the interests of my particular department.

As to our prosecutions for violation of State statutes concerning forest protection, we have not been successful in obtaining convictions. In no instance has a case been found of trespass on State school lands which was not barred from criminal action by the statute of limitations. A number of excellent cases of illegal timber cutting have been discovered on Government lands, and the evidence secured by us has been referred to the proper Government authorities for action. A number of fire cases have been prosecuted, but the accused have invariably been acquitted. This fact has been extremely discouraging, but it has shown us where the difficulty lay, and how it may be remedied in the future. Under our present law all such cases must be tried before the Justice of the Peace in whose district the offense was committed. As a result, it is impossible to find a jury which is not made up partly or wholly of friends and sympathizers of the accused. I have on several occasions been informed by the Justice presiding, that had the case been tried before himself, instead of a jury, a conviction would have been secured, as the evidence of guilt was clearly conclusive. The defendant is allowed by law the privilege of a trial by jury. It is, therefore, evident that he is not slow to take advantage of a right which lessens his own chances of conviction, and frequently prevents the administration of justice. When the laws cannot be sustained and enforced, it is high time that such statutes should be enacted as will defeat the efforts of those who would disregard the laws of this State, and provide a speedy and effective method for punishing offenders.

In regions where lumbering is the chief occupation, all the inhabitants are dependent principally on this industry for their support. It is cer-

tainly unreasonable to expect to find a jury in such a locality who will have the independence of mind and respect for law to sustain and enforce a statute directed against their own interests. When summoned to decide as to the guilt or innocence of a neighbor charged with fire-setting, they uniformly agree to render a verdict of "not guilty," although I have known them frequently to conclude among themselves that the defendant was really responsible for the fire.

To illustrate the difficulties in the way of securing convictions, I will refer to the case of The People vs. Robert Gordon, which was tried in San Mateo County during the early part of this year. The defendant, Gordon, was seen to start a fire in the brush, and then abandon it. The fire rapidly spread, until it had destroyed several thousands of acres of valuable redwood timber. All the circumstances connected with the case went to show that the fire was started for purposes of retaliation. Upon trial the jury were convinced that Gordon was guilty, but acquitted him on the ground that if convicted it would take all of his property to pay the fine. This, the jury considered, would work too great a hardship on the man.

In my opinion, there is but one possible remedy for this deplorable condition of affairs, and that is by changing the place of trial for such cases from the Justice's to the Superior Court. This can be done by amending Section 384 of the Penal Code. The section reads as follows:

Every person who willfully or negligently sets on fire, or causes or procures to be set on fire, any woods, prairies, grasses, or grain on any lands in this State, is guilty of a misdemeanor, and is punishable by fine not exceeding *five hundred dollars*, or imprisonment not exceeding *six months*, or by both such fine and imprisonment.

I would suggest that the words "five hundred dollars" be amended so as to read "one thousand dollars," and that "six months" be amended to read "one year."

These amendmends would simply be a revival of the penalty attached to a similar statute enacted in 1872, and constitutes a far more adequate punishment for the offenses referred to. The increased penalty would, under existing statutes, throw the jurisdiction of all such cases into the Superior Court. Then we could reasonably expect to impanel juries whose members reside far enough from the scene of depredation as not to be in sympathy with the defendant or his acts, and therefore more liable to arrive at a verdict, based on an impartial consideration of the facts connected with the case.

The question of forest fires is a serious one for this State. Very few persons understand their destructive power; very few realize the poverty and desolation that follows in the path of such ruinous visitations; and but few pause to consider that in most cases some one person is criminally responsible for this wholesale devastation. During the summer months extensive forest fires prevailed throughout the mountain regions. It is true, some of these are unavoidable, but the vast majority are the result of negligence and carelessness, and their originators should be promptly prosecuted when discovered.

The most destructive fires that I have ever witnessed were set by sheep men, for the purpose of removing chaparral and undergrowth, in order that a crop of grass might result the next season. It is evidently useless to prosecute those whom we believe responsible for the fires, unless they are directly caught in the act. To watch and detect violations of the law would require a large force of patrols, a costly and at present impossible undertaking. As these ranges are mostly on unentered and unsurveyed Government lands, a cheaper and more effective method of procedure

would be to secure the passage of an Act of Congress prohibiting the use of these lands for such purposes. It would then be a comparatively easy task to remove from those regions this nomadic and irresponsible class of men.

Another important source of fires arises from the annual attempts to clear off land, fire being resorted to as the most effective and economical method. The favorite time for clearing land is during the fall months of the year, when the grass and brush will readily burn. The danger from such fires prevails in California to a much greater extent during our prolonged dry season, as all vegetation is then highly inflammable, and the difficulty of controlling fires is thereby greatly increased.

I have seen large areas of territory completely devastated by fire, the result of some careless settler's attempt to clear his land for cultivation. I have seen hundreds of acres of valuable timber blackened and scorched on the mountain sides, standing there as monuments to a reckless and improvident people. It is only when such destruction and loss comes home to one personally, that he truly realizes what danger and waste these fires represent. There are many who claim that fire is indispensable to the successful clearing of land, and that with proper care their spread can be averted. My own observations have convinced me that such claims are overdrawn. In spite of the utmost precaution, and the presence of a large force of men, the rising wind will frequently sweep the fire beyond control, and then the resulting damage is incalculable. Our farmers should feel some degree of protection in their homes, and not live in fear lest through the negligence of some neighbor they should suddenly be deprived of the accumulations of long years. The laws should aim to protect the innocent against such possibilities. It is a poor law that permits danger to menace the toilers of our land, in order that the convenience and profit of others may thereby be favored.

For over thirty years the State of Massachusetts has had a statute in successful operation which strictly prohibits the setting of fires for clearing purposes during those months of the year when danger is to be apprehended from their existence.

California may well imitate her sister State in this respect by enacting a law which will make the setting of such fires a misdemeanor, the prohibition to extend from about the first day of July to the first day of November. This would carry the time beyond the season of dry and scorching weather, and, as a general thing, beyond the first rains. Fires could then be used with but little danger, and the amount of damage greatly lessened. Such a law, rigidly enforced, would annually preserve large areas of forest lands from the ravages of fire as well as protect the property of numerous farmers and settlers who are often the victims of fires set on neighboring ranches and guarded with a negligence that is clearly criminal.

As I have before stated, although our prosecutions have not proved successful from a legal point of view, yet they have accomplished much for the cause of forestry in this State. By their means the existence of a Forestry Commission has been brought home to the people, enlightening them as to the laws against forest destruction and convincing them that depredators will be prosecuted when discovered. This may truly be regarded as a great step in advance of the past attitude of the State with respect to this question. No wide-reaching reform can be effected in a day; the process is slow and tedious. Our State extends over a broad and diversified country. Many places are difficult of access. Time is necessary to thoroughly reach, inform, and convince the people that we are in earnest in this matter.

During the present year we have noticed a vast improvement in matters of forest preservation. Greater care has been observed on all sides. People are beginning to realize that timber lands are worthy of better care and attention; that they should be guarded more sacredly from destruction. Fires are also less numerous, and a more wholesome respect for the law has been created. With proper legislation and efficient management, there is no reason why this State cannot be brought well into line in the economical disposition of its forests.

It is commonly stated in works on forestry, that the destruction of trees and brush on our mountain slopes is inevitably followed by a diminishing of the water supply of that region. My own experience and observation in various parts of this State confirm all such statements. I have seen districts which were formerly well supplied with running streams. The subsequent denudation of neighboring forests by fire caused a remarkable decrease in their water supply. I have met many persons during the past year whose testimony will substantially corroborate my own in this respect. I am satisfied that this State cannot too soon adopt stringent measures to protect the destruction of its forests. By prompt action a great public calamity can be averted.

When the first attempts were made by this Board to enforce the laws against forest destruction, large tracts of State school land were open to entry. Most of this land had been invaded to a greater or less extent by the depredator, who was rapidly appropriating to his own use all timber of value, without which the land was comparatively worthless. Since that time, owing to the aggressive attitude assumed by the Board of Forestry, the entry and sale of these lands has been wonderfully increased, and to-day but little valuable land of this kind remains unsold. It is gratifying to know that the School Fund of this State is coming into rightful possession of the money derived from the sale of these lands; and we believe that to this Board is due much of the credit for bringing about this desirable result.

Among the many disadvantages under which it has been the necessity of the agents of our Board to labor, none has given more trouble and annoyance than that of securing affidavits from witnesses concerning depredations. All timber agents of the United States Government are duly authorized to take such affidavits and administer oaths in person. This is a great convenience to the agent, as he frequently finds himself in remote parts of the country, far from the residence of a proper officer of the law. In framing the statute creating the powers of the Board of Forestry, this important matter was overlooked, in consequence of which it has frequently been necessary to carry a Notary Public or Justice of the Peace for many miles, for the purpose of administering oaths to necessary witnesses. All this involves additional time and expense, and should be remedied in the future. The next Legislature should confer such authority on the officers commissioned by the Board of Forestry as will permit them to take all necessary affidavits and depositions in person.

During the past year a large portion of my time has been occupied in attending to the many business interests connected with the forestry stations at Chico and Santa Monica. In order to extend the work of the Board in the way of experimental forestry, I have made some attempt to increase the number of these stations. To this end I have solicited donations of land, keeping in view the fact that such stations should be located in a different and distinct climatic belt. As a result I have obtained deeds for two finely located stations. One of these is situated near the town of San Jacinto, San Diego County, and is the gift of the Hemit

Land and Water Company. The tract consists of one hundred acres with water rights, its value being estimated at $15,000. The other station is located near the town of Merced, and comprises forty acres with water rights. The donors of this land are Mrs. A. A. Dunn, V. C. W. Hooper, C. H. Huffman, and the heirs of the Hill estate. At the present time I am negotiating for a station in Livermore Valley, Alameda County, and expect to bring the matter to a successful conclusion.

And now briefly to recapitulate the foregoing suggestions, I will state them as follows:

1. That Section 384 of the Penal Code should be so amended as to fix the maximum penalty at *one thousand dollars*, or *one year's imprisonment*, or by both such fine and imprisonment.

2. That a law should be enacted having the same penalty attached thereto as the preceding, making it a misdemeanor to set fire to any stubble, brush, or forests, for the purpose of clearing land, said law to be in force each year from the first day of July to the first day of November.

3. That all officers and agents commissioned by the State Board of Forestry should be authorized by law to take all necessary affidavits and depositions required by them in the successful performance of their work.

Respectfully submitted.

EDWARD L. COLLINS,
Special Agent for State Board of Forestry.

REPORT

OF THE

Botanist of the California State Board of Forestry,

J. G. LEMMON.

No. 8.—*Pinus Parryana*, Engelm.—Parry Pine, San Rafael Mountains, Lower California. Alt. 4,000 feet.

LETTER OF TRANSMITTAL.

LEMMON HERBARIUM, CALIFORNIA HALL,
CLAY STREET, OAKLAND, CALIFORNIA.

To the Honorable, the California State Board of Forestry—ABBOT KINNEY, *Chairman*; JOHN D. SPRECKELS, WALTER S. MOORE; SANDS W. FORMAN, *Secretary:*

GENTLEMEN: Herewith I have the honor to submit my first report upon the forest trees of the Pacific Slope, particularly of California.

On the first day of April last, Mrs. Lemmon and myself entered upon the services of your honorable body, a commission being soon after issued to me as Botanist for the California State Board of Forestry, and one to Mrs. Lemmon, as Artist for the same.

We at once set about the duties indicated by our appointments, respectively, holding frequent consultations with the Chairman and other members of the Board as to the amount, character, and kind of investigation desired, resulting in the selecting by us of the order of cone-bearing trees for present study, and for the first season—as being sufficiently large and important—the included family of pines.

While thus limiting the investigation to one class of trees, on the other hand it was suggested by us that the treatment of the California pines practically involved the history of those of the whole natural division of the Pacific Slope, and the scope of our investigations was therefore enlarged to comprise "Pines of the Pacific Slope."

In the prosecution of our duties we have explored every special forest region of the State—nearly every county—and the result of our collections and studies, added to those of previous labors in the same direction for many years, is shown in accompanying report.

It will be seen that the papers submitted cover a great many topics conceived of as being either directly in line, or at least germane to the leading subjects discussed—our Pacific forests.

After introductory statements treating of ocean currents, atmospheric conditions, and land configuration—the several factors of forest production—a brief general view is taken of the Pacific forests, and especially of the chief of them all, the Sierra Nevada and his Royal Robe. Then follows a Conspectus of the order of Cone-bearers and tables showing distribution, etc., after which the main body of the work is reached—the Pines of the Pacific Slope, giving first a descriptive list of the groups and species.

In this will be found a new classification, to which I call the especial attention of the Board, and of readers generally, as being an attempt to so classify, name, and simplify descriptions as to popularize the study of our interesting pines by the ordinary reader, who is often deterred from such study by the many technical particulars used in most works of instruction or discussion.

Following the "descriptive list" are extended descriptions of each of the California species, including in most instances a history of their discovery. A special investigation of two of our most valuable lumber trees—*Pinus ponderosa* and *P. Jeffreyi*—follow, after which are placed "Pines in Litera-

ture;" and various topics of interest, including the discussion of the microscopic and other abstruse characters which, however, are necessary to a correct and full study of the pines, and are presented in a paper by themselves, "The Diagnosis of the Genus Pinus," placed at the end of the report.

Artotype illustrations, twenty-four in number, from photographs taken in the forests of characteristic trees, and from prepared specimens of cones, flowers, leaves, seeds, microscopic cross sections of leaves, etc., taken in our herbarium at Oakland, have been carefully prepared, under the supervision of Mrs. Lemmon, by Britton & Rey of San Francisco, at great expense.

The larger and more elaborate water-color paintings by Mrs. Lemmon, treating closely of details, life size, of our California pines, could not be chromo-lithographed for this report, owing to the much greater expense of such works; but they will be perfected in certain details and augmented by other paintings, completing the series of California pines, when, it is hoped, a future report may be accompanied by these finished and most instructive illustrations.

In order to minimize the typographical errors that would necessarily occur in the hurried work of the State printers of such subjects as botanical descriptions, I have had printed in Oakland, where I could read the proof often and correct the work critically, the "descriptive list" of the pines of the Pacific Slope, a correct copy of which is inserted in place in the manuscript of this report.

ACKNOWLEDGMENT OF AID.

Acknowledgments of important aid are hereby expressed of assistance from a large number of persons and corporations who have kindly assisted in the prosecution of our researches, and the collection of materials, specimens, etc., for this and perhaps other subsequent reports. First of all is the acknowledgment of indebtedness to the Directors and other officials of the Southern Pacific Company's system of railways, who have issued passes and given transportation facilities on their various lines of travel, without which little could have been accomplished by persons of limited means in a vast region like ours, with its many forest headquarters so widely distributed.

The same acknowledgments, but in a less degree, are due for similar reasons to the Atchison, Topeka and Santa Fe railroad system, California Southern, Donahue system, the several Oregon railways, the Pacific Steamship Company, International Land and Transportation Company of Mexico, etc., and the proprietors of several interior stage lines.

Material assistance has been received from Professor E. L. Greene, of the California State University, for the privilege of consulting old authors in his possession, and from Dr. C. C. Parry, of Davenport, Iowa, for same; from Dr. W. H. Harkness, President of the California Academy of Sciences, for the elucidation of tree fungi, and to T. S. Brandegee of same for notes on a new location for Pinus Torreyana.

Special acknowledgment of valuable assistance is hereby given the following persons among the many who have aided us in the arduous and prolonged field work:

J. S. Taylor	Del Mar, San Diego County.
Mrs. Lil. Bennett	Del Mar, San Diego County.
Hon. Abbot Kinney	Lamanda Park, Los Angeles County.
H. B. Muscott and family	San Bernardino, California.
Col. W. W. Hollister	Santa Barbara, California.
Mrs. Lucy H. Brown	Santa Barbara, California.
Mrs. Fred. Bartlett	Santa Barbara, California.

Mr. and Mrs. Elwood Cooper	Santa Barbara, California.
John Spence, florist	Santa Barbara, California.
W. E. Brokaw	Keene, Kern County.
John Nelson	Tehachapi, Kern County.
J. M. Hutchings	Yosemite, Mariposa County.
Mr. and Mrs. E. W. Steele	San Luis Obispo, San Luis Obispo County.
W. P. Murphy	San Luis Obispo, San Luis Obispo County.
Mr. and Mrs. S. M. Dyer	Starkey, San Luis Obispo County.
Mr. and Mrs. W. R. Rockwell	Starkey, San Luis Obispo County.
Mr. and Mrs. G. W. Brown	Cholame, San Luis Obispo County.
J. O. Johnson	Pacific Grove, Monterey County.
F. N. Gomez	Monterey, Monterey County.
John Myers	Monterey, Monterey County.
Dr. C. L. Anderson	Santa Cruz, Santa Cruz County.
Mrs. M. H. Field and family	San José, Santa Clara County.
Stephen Nolan, florist	Oakland, Alameda County.
John Muir and family	Martinez, Contra Costa County.
F. A. Warner and family	Healdsburg, Sonoma County.
C. F. Sonne	Truckee, Nevada County.
J. B. Tiffany	Truckee, Nevada County.
Mrs. M. E. P. Ames	Auburn, Placer County.
Mrs. Jennie Hughes	Auburn, Placer County.
B. Frank Lemmon and family	Sierraville, Sierra County.
Judge W. C. Lemmon	Sierraville, Sierra County.
Mr. and Mrs. Peter Oleson	Randolph, Sierra County.
Mrs. Rhoda A. Thompson	Quincy, Plumas County.
Mrs. R. M. Austin	Quincy, Plumas County.
J. H. Sisson	Berryvale, Siskiyou County.

Individuals outside of California who have rendered much assistance are:

John W. Young	Flagstaff, Arizona.
John F. Scott	Williams, Arizona.
Dr. and Mrs. J. L. Ord	Fort Bowie, Arizona.
Captain W. A. Rafferty	Fort Bowie, Arizona.
General E. A. Carr	Fort Lowell, Arizona.
J. P. Igo and family	Fort Huachuca, Arizona.
E. O. Strattan	Santa Catalina, Arizona.
Paul Plummer	Tucson, Arizona.
Marmon Brothers	Laguna, New Mexico.
F. W. Peters	Carson, Nevada.
Dr. L. E. Jones	Salem, Oregon.
Prof. C. R. Brown	Portland, Oregon.

The field work has been supplemented by historical data, derived in part from the libraries of the State University at Berkeley, the Public Library of Oakland, and those of the Mercantile, Mechanics, Odd Fellows, and Public Libraries of San Francisco, and other sources.

All of which is respectfully submitted.

J. G. LEMMON,
Botanist for the California State Board of Forestry.

November 1, 1888.

INTRODUCTION.

Pliny, the naturalist, living near the commencement of the Christian era, wrote in one of his thirty-seven books, *Naturalis Historia*, after discussing the two other kingdoms of nature—minerals and animals: "It now remains for us to speak of the vegetable productions which," he declares, "are equally far from being destitute of vital spirit." * * * "It was from the forest that man drew his first aliment; by the leaves from the trees was his cave rendered more habitable, and from their bark was his clothing supplied." * * * "The trees formed the first temples of the Gods, and even at the present day the country people, preserving in all simplicity their ancient rites, consecrate the finest trees in their vicinity to some divinity.

"In more recent times," he continues, "it was the trees that, by their juices and gums more soothing than corn, first mollified the asperities of man; but in addition to this the trees have a thousand other uses, all of which are indispensable to the full enjoyment of life.

"It is by the aid of timber trees that we plow the deep and bring to our stores the wealth of far distant lands.

"It is by the aid of trees that we construct our edifices. The statues of the deities even were formed out of the easily fashioned woods of the forest."

In speaking of resin trees, he says: "Whereas there are in Asia several trees that produce pitch, in Europe there are but six."

Enlarging the observations of the wise old Roman philosopher by the accumulated knowledge of nearly twenty centuries, and circumscribing our view to the timber trees under consideration of the same family as those which Pliny and his predecessors called characteristically, the "pitch trees," we may truthfully say that few orders of plants are of more importance to man at this far riper age of the world, whether we consider them with reference to food, to clothing, for fuel, or for building purposes, than this family of trees we are about to discuss—the noble order of *coniferæ*, or cone-bearers.

CONIFERÆ, OR CONE-BEARERS.

The cone-bearers mostly inhabit the colder parts of the earth, whether alpine or circumpolar, and are usually readily recognized at sight as resinous, mostly evergreen trees or shrubs, with usually needle-shaped or scale-like, mostly rigid, leaves; the male flowers reduced to stamens only, upon a usually elongated central axis; the female flowers—aments—consisting of few or many scales, becoming in most families a dry *strobile*, or cone. Not a species of them all is either noxious or useless. Most of them are very valuable, and among them are the most beautiful and the noblest trees that clothe the earth.

Climatic Conditions. and Results.

The cone-bearers are found almost exclusively in the cold or temperate parts of the earth, the tropical plants of this order inhabiting, mostly, the high parts of the mountains, hence the land surface in the two wide circumpolar regions, north and south, furnishes the principal home of the conifers. In these zones the cone-bearers outnumber the non-resinous, deciduous leaved trees (example, oak, ash) ten to one.

Comparing the two regions, great disparity is found to exist between the characters and the number of the species, those of Australia, New Zealand, and Patagonia differing widely from the more abundant and typical conifers of their antipodes in Northern America, Europe, and Asia.

One suborder and several entire genera, with very numerous species in the northern zone, are entirely absent from the southern one, while in the latter there are found many peculiar genera with, however, a single or but a few species in each.

Again, the separation of the land surface into continents by the great oceans, Pacific and Atlantic, has produced radical changes or modifications of original types, amounting often to generic or family differences.

Continuing this inspection of the habitat of the conifers, equally interesting facts appear by comparing the forest growths on opposite sides of the two continents, Eastern and Western. Confining attention to the Western Continent, remarkable distinctions are detected, owing mainly to the greatly unlike, in fact, diametrically opposite, conditions of the ocean currents that wash its opposite shores, and to the trend of the two principal ranges of mountains that divide its plateaus.

The warm gulf stream passes along northeastward, near the Atlantic Coast, and parallel to the great Appalachian chain of mountains, while the less warm Ku-ro Si-wa, or Japan current, comes down from the northwest and passes along the Pacific Coast parallel with the great Rocky Mountain and Sierra Nevada Ranges.

These dominant currents and ranges, if prolonged, would intersect each other nearly at right angles on the Isthmus of Tehuantepec.

The ocean winds crossing those currents are warmed, and consequently saturated with moisture which, as it is carried inland, meets with the colder land surfaces, especially of high mountains, and is there condensed and precipitated thereon, giving origin to forests.

Where these currents infringe closely upon the coast, and are, moreover, delayed and accumulated by obstructing islands or promontories, as instanced on our northwest coast, *there* we find the greatest precipitation and the noblest forests.

The Gulf Stream passing along near the low, flat coast of Florida and the Carolinas gives origin to a vast, but not dense forest—the Southern pine belt—but as the stream is sheared off into the ocean from the northeastern coast of the United States by the cold counter current from Greenland passing down along the New England coast and as far south as Cape Hatteras, this latter coast is cheated out of much of the nourishing vapor, which, instead, is condensed in fogs upon the banks of Newfoundland, while the great Gulf Stream, coursing on across the Atlantic, warms and saturates other air currents, which, drifting inward, meet with and are precipitated upon the Scandinavian Mountains, giving origin to the noblest forests of Europe—the Norway conifer belt.

Similarly the Japan current, sheared off from Eastern Asia by an Arctic counter current, leaves the Siberian coast shivering and almost treeless, while the great current courses across the Pacific as stated, warming and saturating air currents that fall upon the steep mountain ranges of the Pacific Coast and give origin to the Pacific conifer belts—the noblest and densest forests in all the earth.

In this connection it should be stated that the southern pine belt is prolonged westward from Florida along near the coast of the Gulf of Mexico; also, that there exists (or did exist before the acts of man reduced it) an extensive forest of pine in the Great Lake region, but the conditions favor-

ing the growth of these forests, mainly due to the proximity of large bodies of water, cannot be discussed at this time.

The mountain ranges of the Pacific Slope, being three in number, nearly parallel to the coast and successively higher as they arise farther and farther from it, afford three favoring slopes for vigorous forest growth (those facing the west), and upon these, consequently, are found the noble forests mentioned.

The Rocky Mountain Range, distant over one thousand miles from the Pacific, and also much interrupted, receives but a limited amount of rainfall upon its highest portions. On the peaks and in the parks of Colorado, and the elevated regions north and south of this State, are found limited bodies of pine, fir, and spruce, mingled with deciduous leaved trees, while the steep and lofty continuous Cascade and Sierra Nevada Ranges, and the lower, but ocean-skirting Coast Ranges, arrest and receive the greater part of the vapor, the Cascades presenting the matchless Douglas spruce forests of Oregon, while the lofty, dominating Sierra Nevada is clothed with the magnificent yellow and black pine forests.

Similarly, the Coast Ranges at the north yield a second broad belt of Douglas spruce, while the southern portion in California yields the world-famous redwood forest.

Beginning on the southern coast of Alaska, with an annual rainfall at Sitka of over one hundred inches, and passing southward, the precipitation decreases gradually as the temperature of the land rises, until in Southern California, below Point Concepcion, in latitude 35 degrees, the average of land temperature so far exceeds that of the ocean that precipitation is impossible during the greater part of the year, and a vast interior, non-forested region is the consequence.

The depth or character of soils in the Pacific region has little to do with the exuberance of its forests, as shown by the fact that in the redwood forest of the Mendocino coast, where the trees are largest and closest set, the soil is notably of the poorest sort and very shallow.

Some forms or types of trees have the power to preserve their specific character nearly intact through wide regions both of longitude and latitude. Of such are the Douglas spruce (erroneously called in the north Oregon pine) and the yellow pine, both found not only from end to end of all the Pacific ranges, but reaching across to the Rockies and southward to Mexico.

Others are found on the Coast and Sierra Ranges, but limited in latitude, such as the yellow cypress (*Chemæcyparis Nutkaensis*), the Western hemlock (*Tsuga Mertensiana*), and the California nutmeg (*Torreya Californica*), the latter of the closely allied order Taxaceæ.

In a few instances the separation of the ranges by the great valley of California, one hundred to one hundred and fifty miles wide, the disparity of height and consequent rainfall, results in forms so far different as to entitle them to rank as distinct but closely allied species, as follows:

Coast Ranges.	*Sierra Nevada.*
Abies grandis.	Abies concolor.
Pinus contorta.	Pinus Murrayana.
Sequoia sempervirens.	Sequoia gigantea.

As might be expected, less but still considerable differentiation results from difference of latitude on the same ranges, amounting, often, to the grade of a species, most frequently to marked varieties.

Several of the cedars at the north become greatly changed in the south, so also of the cypresses, while the firs (by which is always to be understood

the genus *Abies*, of Link; with cones erect, their scales deciduous from the axis) are in the south so far different as to be considered distinct species. It is curious to notice that the lovely red fir of the Cascades, *Abies amabilis*, has for a companion the white fir, *Abies grandis*, while similarly in the Sierra are found the magnificent red fir, *Abies magnifica*, and the white fir, *Abies concolor*, each pair living together like faithful friends.

Also, it is interesting to note in a general way that while the cognate trees may be reduced in size as progress is made southward, the fruit is often enlarged; thus, the noble red fir of the north, with its medium cones six inches long, is replaced in the south by its twin brother with cones eight inches long. Similarly the great Douglas spruce in Oregon, with its immense trunk and small cones one and a half to two inches long, becomes in the mountains of San Bernardino, California, a dwarfed, gnarled tree, but with immense cones eight or nine inches long.

As a matter of teleological or speculative importance, the favorable conjuncture of ocean and continental conditions described as prevailing on the Pacific Coast, have rendered possible the differentiation, or, perhaps, it would be a better statement of the same truth to say the perpetuation of certain lines of development that are wonderfully unique and startlingly local. Reference is had here to the presence of the beautiful *Cupressus macrocarpa* (Monterey cypress), and *Pinus insignis* (Monterey pine), both limited to a few miles along the Monterey coast; the curious bristle-cone fir (*Abies bracteata*), found only in three certain cañons of the Santa Lucia Mountains, of Southern California, and still more suggestive, the commemorative *Pinus Torreyana*, only a few stunted trees of which are found on sand dunes near the town of San Diego, California, with a smaller growth on one of the channel islands.

One other vestige of a vanishing race remains to be noticed, that of the "Big Tree" (*Sequoia gigantea*), a few trees of which, in about twenty scattered groves located on the southern end of the Sierra Nevada, remain on the earth as the majestic vanguard of a past prodigious flora which once flourished here coeval with the colossal animals of the period.

THE SIERRA NEVADA AND ITS GREAT FOREST.

Preeminent over all forestal regions of the earth are the dense and extensive tree growths clothing the slopes of that most diversified and wonderful of mountain ranges—the Sierra Nevada of Western America.

This lofty, steep, well watered range is the headquarters of the largest and most abundant trees known, including most of our lumber-producing pines as well as most of the lumber trees of other families; hence, a general idea of our timber trees and of their forestal importance can be best gained by a study of them *in situ*, as massed or as distributed upon the flanks of this peculiarly wealthy Sierra Nevada.

For the past twenty years it has been the privilege of the writer either to reside in the Sierra or to explore its forests; hence, he is profoundly impressed with their beauty and value, and he shares with the aborigine the sentiments of awe, the veneration, the personation with which he regards the snow-striped Sierra and its kingly garniture of emerald green.

KING SIERRA AND HIS ROYAL ROBE.

The Sierra Nevada is a rich, lordly, bejeweled prince among mountain ranges.

Other chains of mountains ribbing the earth are usually high-raised elevations, composed principally of rounded mountains, swelling their bosoms to the sky and trailing their tattered garments far out over extensive foothills to the flanking plains.

The long Rocky Mountain Range—the backbone of North America—is of this class; rising so gently from the elevated plains on each side, that the traveler by the transcontinental railroads can scarcely discover that he is ascending an immense upheaval of the earth's crust, or detect the exact point where he crosses the broad saddle of the obscure passes.

But our King Sierra is not so. He is distinguished alike by the traveler or the geographer for the abruptness of his majestic uprise from the plain, the splintered and rough-hewn forms of his thousand peaks, the high elevation of their pinnacles, ever bearing their crowns of snow; but most of all he is preeminent for his bounteous and beauteous enrobing forest, his royal, parti-colored garment.

Like an Oriental monarch, he reclines in state upon the bosom of the great, trackless plain of Western America, enwrapped from head to foot, six hundred miles, and from side to side, one hundred and forty miles, with a dense forest of evergreens, interspersed with many-hued, deciduous-leaved trees, like insertions of brilliant figures in a royal emerald robe.

This enrobing forest, the noblest in North America, is perforated along its raised center line, or axis of the Sierra, by a thousand peaks rising through the mantle into the region of perpetual winter, while both slopes, east and west, are rent by a million valleys depressed through the robe into the middle region of changing seasons, and the fringe of the garment trails out over the domain of almost perpetual summer.

The snow-crowned peaks are the sparkling diamonds of this wealthy prince; the valleys, often still filled with water in their glacier beds, are his resplendent pearls. The former flash upon the voyager floating on the far western Pacific, or the toiler over the wide eastern desert, like beacons of light; but the royal robe, with its decorations of valley and glen, its gems of tree and shrub, flower and fern, reveals itself only to the miner in the cañon, the herdsman with his flocks, the hunter pursuing his game, the curious traveler, or the studious explorer.

But most of all these peculiarities are observed by the lover of nature, he who explores the Sierra with heart attuned and perceptions opened by interior appreciations, for it is an old saying, "'Tis the world within creates the world without." Such a visitor's first emotions are often a mingling of disappointment and delight. If he has explored tropical countries he will be disappointed by the fewness of species here, but surprised by the great number of individual trees, their great size and height. If he is familiar with Arctic regions, he will miss the dwarfed trees and monotony so foreign to the Sierra.

Two other comparisons are pertinent. In tropical countries life presses in and strives to hold the ground against fierce, opposing contestants. This is especially observable in the vegetable world. A small spring issuing from a mountain side in Arizona or Mexico is attacked at its very source, and its waters absorbed by the eager rootlets of a hundred species of plants—a broad-headed hackberry or a tall cottonwood crowning the mass of foliage and striking its roots deepest under the rock floor of the spring. Streams large enough to feed all the gourmands by the way, and yet reach

No. 9.—*Pinus contorta*, Dougl.—Scrub Pine, coast of Mendocino, and in cultivation.

the plain, are marked throughout their course by a narrowing border of vegetation.

Shade and northern inclination favor the retention of moisture and foster vegetation, hence the northern slopes of Arizona mountains are often thinly forested, while the southern slopes may be bare to the pinnacles.

In Arctic climes the cold, long winters forbid all but a few specially hardy plants from maintaining existence. The entire surface of the country being kept moist, the plants are not alone found along stream beds, but equally dispersed, varying only by varying conditions of elevation and inclination; hence, the low plains of Arctic America and the tundras of Siberia afford often vast meadows, composed, however, of but one or two species of sedge.

So, also, extensive forests will be found containing but one or two species of trees, these small, dwarfed, and snow-bent, at length reduced to bushes creeping in the mud on the shores of the Arctic Sea.

The Sierra of California occupies a middle position between torrid and frigid conditions, a position most favorable to the production of large forests containing many species of noble trees and rich valleys of diversified flowers.

The Sierra forest is composed mainly of evergreens, not one species of which is identical with the trees of the East—with the exception of a dwarfed variety of an eastern juniper—but it shares several species with the Rocky Mountains on the east and the coast mountains on the west of its position.

Chief of these evergreens is the chief of all trees, the great *Sequoia*, or Big Tree, the bare mention of which is sufficient here.

FIR TREES OF THE SIERRA NEVADA.

Next to the Big Trees in size, but far excelling them in loveliness, are the four species of *Abies*, or fir trees, arranged in pairs, as "red-barked" firs and "white-barked" firs. But they train together oddly; each red fir has a white, smaller brother in attendance, like Don Quixote and his squire Sancho Panza. *Abies nobilis* and *Abies grandis* masquerade as giants through the forests of the northern Sierras, while *Abies magnifica* and *Abies concolor* personate them southward.

The firs until recently were called pines, but they are at once distinguished by their symmetrical shape, especially when young, which is always conical or fusiform. The limbs radiate horizontally in verticils or whorls of three to nine each. The branches and twigs, also the leaves on lower limbs, are all flattened horizontally; hence, the spreading limbs resemble lovely fans which, nearly touching each other at the sides, form stratum after stratum of airy basket work, in a diminishing series from bottom to top.

The cones of the firs are borne on the uppermost limbs, and they stand upright on terminal robust twigs. They are composed of numerous close-set scales, which fall away at maturity, together with the large-winged seeds, leaving the receptacle, or naked core of the cone, persistent upon the tree; hence, fir cones are never found lying about under the trees, as are those of the pine, spruce, cypress, and other trees.

Travelers aver that no trees known exceed the red firs of California in their grand, symmetrical uprise in airy, diminishing wicker-baskets of foliage. One has but to visit a grove of these stately trees, notably around the base of Shasta, to receive impressions of grace, beauty, majesty, and perfection that will serve for mental enjoyment while memory lasts.

SPRUCES OF THE SIERRA.

Next to the firs in conspicuousness are the spruces of the Sierra. There are but two of them, *Pseudo-tsuga Douglasii* (Douglas spruce) and *Tsuga Pattoniana* (hemlock spruce). The spruces differ from the firs principally in having petioled or stalked leaves, cones borne on any of the limbs instead of the upper only, pendulous and with persistent scales. They differ from the pines by having their leaves solitary, not sheathed at base; cones maturing in one season instead of two, the scales without prominences, spines, or prickles.

The Douglas spruce is the largest and principal tree of the Oregon forests, two hundred and fifty to three hundred and fifty feet high and twelve to fifteen in diameter, with a usually fusiform symmetrical shape, black, deeply-cleft, strong bark, and often long, depending twigs of foliage resembling cat's tails. The wood is usually hard, strong, and durable, but varying greatly with age and conditions of growth, giving lumber dealers occasion to apply several names to the timber. In Oregon and vicinity this tree is miscalled "Oregon pine," and is so designated by most dealers elsewhere. The cones are small, oval, two to three inches long, with rounded, convex, smooth scales, and long, narrow bracts exserted three fourths of an inch, and three-parted, the middle segment, or midrib subulate, one half inch long. In the Sierra the Douglas spruce does not attain so great proportions, but is still a very large, majestic, and very valuable tree, much used for lumber, and largely planted for shade and shelter from winds. Growing at elevations from sea level to ten thousand feet, it sometimes forms extensive bodies, to the exclusion of all other species, but is generally attended by other trees, among which it is always distinguished for its bright green foliage, its symmetrical form, its finely drooping branchlets, and beautifully bracted cones.

The Hemlock spruce is less common in the Sierra, being found only near the timber line of the highest peaks. Northward, in the Cascades of Oregon, it becomes a tree of the first class, often attaining a height of one hundred and fifty feet, with a diameter of seven to ten feet. It is a very beautiful tree of pyramidal outline, the lower branches the longest in open situations, diminishing regularly to the top, which ends in a long spire. The limbs at first are directed downward then outward, and at length upward, the twigs again drooping and bearing the small purple cones like thimbles on the ends of widely spreading fingers.

The bark of the Hemlock spruce is thin, strong, grayish, and finely checked; the wood light, soft, close-grained, tough or brittle, varying greatly according to age and conditions. This tree is often called "silver spruce," from the bright sheen given to its foliage by the lines of stomata along its small, short leaves.

One can hardly picture, without experience in our California forests, the exceedingly beautiful effect upon the Alpine landscape, due to the presence of the Hemlock spruce, as it is grouped into silver shields, or bosses, or disposed as tinseled fringe or ruffles along the timber line, with the emerald bands of fir below them, and the deep, sea-green pines with their intervals or insertions of parti-colored, deciduous trees supplementing all, and completing this royal robe.

BRIEF CONSPECTUS OF THE ORDER OF CONIFERÆ OR CONE-BEARERS.

The cone-bearers are resinous juiced, mostly evergreen trees, with either scale-like or needle-shaped leaves; flowers of two sorts, male or pollen bearing, and female or fruit bearing; these either separated and upon the same trees or upon different trees, the female consisting of very much modified leaf organs having the form of scales or membranes, with contained seeds, becoming a dry cone in fruit (or berry-like in juniper) seeds two or more, naked or winged, embryo straight, in oily albumen; cotyledons generally several in a whorl.

The cone-bearers are divided into three tribes: CUPRESSINEÆ, TAXODINEÆ, and ABIETINEÆ.

TRIBE I—CUPRESSINEÆ.

Scales of the fertile aments, opposite, in pairs, becoming a small dry cone, or a drupe-like berry in juniper; leaves opposite or ternate, often dimorphous.

A large tribe of five genera: Juniperus—the junipers; Cupressus—the cypresses; Chamæcyparis—the hemlocks; Thuya—white cedar; Libocedrus—incense cedar.

TRIBE II—TAXODINEÆ.

One genus only: Sequoia—big trees.

TRIBE III—ABIETINEÆ.

A large tribe of five genera:

No. 1. ABIES—The fir family: Leaves sessile leaving circular scars when they fall; cones erect on the upper limbs, their scales deciduous from the axis; seeds with resin vesicles.

No. 2. PSEUDO-TSUGA—Douglas spruce: Leaves petioled (stalked), the scars transversely oval; cones pendulous; scales persistent; seeds without resin vesicles.

No. 3. TSUGA—Hemlock: Branchlets rough from the prominent persistent leaf bases; bracts of the cone smaller than the scales; cones pendulous; seeds with resin vesicles.

No. 4. PICEA—Spruces: Trees having also the characters of the last, except leaves sessile; seeds without resin vesicles.

No. 5. PINUS—Pines: Cones requiring two years to complete their growth, their bracts becoming corky and thickened, leaves (the conspicuous foliage) in fascicles of two, three, or five (solitary in one species), and surrounded at base by a sheath of scarious bud-scales; pollen, two-lobed.

DISTRIBUTION OF THE CONIFERÆ.

The cone-bearers of the Pacific Slope, classed in three sub-orders or tribes, as shown in the foregoing, comprise fourteen genera and fifty-two species.

They are distributed as hereafter shown. For convenience the mountains of the whole Pacific region are divided into two sections by a conventional line drawn eastward from the Bay of San Francisco, with a supplemental southern region divided between Arizona and New Mexico.

Northern Coast Ranges possess	21 species.
Southern Coast Ranges possess	21 species.
Total	42 species.
Northern Cascade Mountains possess	16 species.
Southern Cascade Mountains possess	13 species.
Total	29 species.
Northern Sierra Nevada Mountains possess	20 species.
Southern Sierra Nevada Mountains possess	22 species.
Total	42 species.
Northern Rocky Mountain range possesses	17 species.
Southern Rocky Mountain range possesses	11 species.
Total	28 species.
Arizona mountains possess	13 species.
New Mexican mountains possess	12 species.
Total	25 species.

The species found in the several districts are shown in the following table:

Libocedrus decurrens—incense cedar		1		1	1	1				
Thuya gigantea—red cedar	1		1				1			
Chamæcyparis nutkaensis—Sitka cypress	1		1							
Chamæcyparis Lawsoniana—Port Orford cedar	1				*1					
Cupressus macrocarpa—Monterey cypress		1								
Cupressus Goveniana		1			1					
Cupressus McNabiana		1								
Juniperus Californica and var. Utah		1				V.1			V.1	
Juniperus occidentalis and vars.				1	1	1		V.1	V.1	V.1
Sequoia gigantea—big tree						W.1				
Sequoia sempervirens—redwood	1	1								
Taxus brevifolia—yew	1	1			1	1	1			
Torreya Californica—California nutmeg	1	1			1	W.1				
Pinus monticola—mountain pine	1		1		1	1	1			
Pinus Lambertiana—sugar pine	1	1	1	1	1	1				
Pinus flexilis—white pine						1	E.1		N.1	1
Pinus albicaulis—white stem pine	1		1		1	1	E.1			
Pinus reflexa—Arizona white pine									N.1	1
Pinus Parryana—Parry's pine		1								
Pinus cembroides—nut pine									1	
Pinus edulis—"Piñon" nut pine								E.1		1
Pinus monophylla—Washoe pine						E.1				
Pinus Balfouriana—foxtail pine					1			1		
Pinus aristata—bristle-cone pine						1		1	1	1
Pinus Torreyana—Torrey's pine		1								
Pinus ponderosa—yellow pine	1	1	1	1	1	1	1	1	1	1
Pinus Jeffreyi—black pine					1	E.1				
Pinus Arizonica—Arizona pine									1	1
Pinus Chihuahuana—Chihuahua pine									1	1
Pinus contorta—scrub pine	1									
Pinus Murrayana—tamarack pine			1	1	1	1	E.1	1	1	N.1
Pinus Sabiniana—gray leaf pine	1	1			1	1				
Pinus Coulteri—big-cone pine		1				1				
Pinus insignis—Monterey pine		1								
Pinus tuberculata—knob-cone pine	1	1		1	1	1				
Pinus muricata—prickle-cone pine	1	1								
Picea alba—white spruce	1						1			
Picea Engelmanni—spruce			1	1			1	1	1	1
Picea pungens—blue spruce							1	1		
Picea Sitchensis—tide land spruce	1									
Tsuga Mertensiana—hemlock	1	1	1	1			1			
Tsuga Pattoniana—hemlock			1	1	1	1	1			
Pseudo-tsuga—Douglas spruce	1	1	1	1	1	1	1	1	1	1
Pseudo-tsuga—var. macrocarpa		1				†1				
Abies sub-alpina—balsam fir			1				1	1		
Abies grandis—N. white fir	1			1			W.1			
Abies concolor—S. white fir				1	1	1		1	N.1	N.1
Abies bracteata—bristle-cone fir		1								
Abies amabilis—beautiful fir			1	1						
Abies nobilis—noble red fir	1		1		*1					
Abies magnifica—great red fir					1	1				
Larix occidentalis—tamarack			E.1				W.1			
Larix Lyallii—Oregon tamarack			1				1			
Totals in each division	21	21	16	13	20	22	17	11	13	12

* Shasta. † San Bernardino.

Twenty-three pines, 18 in California; 5 cypresses, all in California; 5 spruces, 3 in California; 7 firs, 5 in California; 4 cedars, all in California; 2 junipers, both in California.

NOMENCLATURE.

In the infancy of botanical science, and indeed until very recently, the word "pine" was applied not only to true pines as we now know them, but to spruce, fir, larch, and cedar as well, and "pine" is still so employed in Europe by most travelers, artists, and poets.

Lately botanists have detected important lines of development separating the true pines from the other families, but while the pines now are usually quite readily distinguished, the numerous species—now over seventy-five known to science—differ so little from their nearest allies that satisfactory classification of them involved an immense amount of collecting, research, and comparison, resulting at present in a very natural method of classification.

The earliest classifications were based upon the number of leaves in a fascicle, making one group with leaves in twos, another in threes, and the third in fives, while subdivisions depended upon the size of seeds, their condition, whether "wingless" or "winged," etc., all of which failed of certainty.

Endlicher, in 1847, first discovered that the cone scales afforded important distinctive characters for separating the large family into two sections. But the subdivisions of Endlicher and his followers were based upon the number of leaves in the fascicles, size of seeds, etc., distinctions that are inconstant and so this classification was faulty.

The late Dr. George Engelmann devoted over fifty years of a busy life to the elaborate study of certain abstruse families of American plants, including nearly all our forest trees, and with most profound and gratifying results, published from time to time, especially in classifying our cone-bearers.

He found with Endlicher that the characters of the fruit scales were of first importance, and, moreover, that they correspond with series of other characters, which constitute two very natural sections of the genus, especially the characters of the wood, popularly separating the family into white pines and pitch pines. Subsections of these he based upon his lately discovered microscopic characters of the leaves; especially the position of the longitudinal resin ducts within them.

These he found were in three relative positions as regards the surface: (1) peripheral, near the epidermis; (2) parenchymatous, imbedded in the fundamental tissue; or (3) internal, on or near the central fibro-vascular bundle.

Subdivisions of these groups, again, were determined by the position of the cones as being either (1) subterminal, near the leaf-bud; or (2) lateral, along the side of the growing shoot; and lastly (what was first with the early botanists), the number of leaves in a sheath, their persistence, and the persistence of the cones, was considered.

Accepting the most of Englemann's conclusions with profound gratitude, but at present disregarding his microscopic distinctions as being too recondite or too troublesome for the general reader, I offer a new classification of Pacific species based chiefly upon plainly evident characters of the cone, subsequently noting the other characters in the order of their importance.

Readers desirous of pursuing the technical histology of the subject farther are referred to the "Diagnosis of the Genus Pinus" at the end of these contributions.

PINES OF THE PACIFIC SLOPE.

No. 12.—*Pinus Jeffreyi*, Murr.—Black Pine, *var.* Peninsularis, San Rafael Mts., Lower California. Alt. 4,000 feet.

PINES OF THE PACIFIC SLOPE.

PARTICULARLY THOSE OF CALIFORNIA.

By J. G. Lemmon, Botanist for the California State Board of Forestry.

A New Classification with Named Divisions, Groups, Etc., Based upon Plainly Evident Characters, Chiefly of the Fruit or Cone.

"By their fruits ye shall know them."

WHAT ARE PINES?

Briefly: A pine tree usually affects a cold or temperate climate, and is usually readily distinguished as a resin-producing, cone-bearing evergreen tree, with principal foliage composed of secondary leaves, which are acerose (needle-shaped), usually rigid, mostly triangular, and in fascicles or bundles of 2–5 each (solitary and round in one species), their bases surrounded by a sheath of scarious bracts or bud scales, usually close-wrapped and persistent.

The flowers are *monœcious*, *i. e.*, they are on the same tree but separated, the male or pollen-bearing on a different branchlet from the female or fruit-bearing one which becomes the cone. The fruit is either sub-terminal, *i. e.*, arising near the terminal leaf-bud, or it is lateral, arising along the stem among the leaves of the growing shoot. It is composed of numerous spirally-imbricated, carpellary scales, each in the axil of a thickened, corky bract (much modified and concealed at maturity), and each bearing two, usually long-winged, seeds at base; the whole fruit requiring two years to complete its growth (three for one European species), and becoming a coriaceous (leathery) or ligneous (wood-like) *strobile* or cone. Cotyledons or seed-leaves numerous, in a whorl of 4–16.

The pines are naturally divided into two classes or sub-genera, called technically, *strobus* and *pinaster*, respectively, from the name of typical species in each; in this publication given also other names.

CLASS I. SMOOTH-CONED, WHITE PINES.

(SUB-GENUS STROBUS of Botanists.)

Cone-scales smooth, devoid of protuberances, prickles, or hooks; wood usually lighter colored, softer, and less resinous than that of the other class. (Exception: our Sugar Pine is often very resinous.)

Cone sub-terminal, mostly long-peduncled and falling at maturity; scales usually numerous and flat. Leaves short, 2–3 inches long, in fascicles of fives each, with short, loose, deciduous sheaths at the base. Male flowers oval, small, $\frac{1}{4}$–$\frac{1}{2}$ inch long; scales 8–15.

Five species on the Pacific Slope, four of them in California, arranged in two groups of a pair each.

GROUP 1. LONG-CONE, LUMBER PINES.

Cone long, cylindrical, 8–20 inches long, and 1–3 inches thick, many-scaled, long-peduncled, becoming pendent. Principal spirals, 8 inclining to the left, 13 to the right. Seeds large, dark, with long, brown, persistent wing.

Trees usually very large, with finely-checked bark, large and long upper, bearing limbs and light green foliage. Timber of the utmost value for lumber.

No. 1. Pinus monticola, Dougl.—Mountain Pine, Finger-Cone Pine.

Sub-alpine, middle-sized, lighter-barked trees than the next, rare in the Sierra and northward. Bark fissured into small square checks. Yearling cones cylindrical, an inch long. Mature cones narrow, 6–12 inches long; scales thin, weak, reflexed at maturity. Seeds and wings smaller and paler than those of its mate. Cotyledons 6–9. Closely resembling Eastern White Pine (*P. strobus*).

Variety *minima*—Little Mountain Pine. Trees and fruit very small; bark thin, smooth, white. Northern cross-ranges and coast mountains, rare.

No. 2. Pinus Lambertiana, Dougl.—Sugar Pine, Gigantic Pine.

Trees often of the largest dimensions 120–300, or, favorably situated, 250–300 feet high and 6–10, rarely 15–20 feet in diameter. Scattered among other trees of the coast mountains and Sierra at middle elevations. Bark thicker, darker than the preceding, and irregularly fissured. Yearling cones long, yellowish or purple, cylindrical, 1–2 inches long with appressed scales. Mature cones long-elliptical, 10–12, rarely 15–22 inches long and 2–3 thick, becoming when expanded 4–6 inches thick. Seeds very large, about ½ inch long, edible, with large wings an inch long and thickly veined with reddish brown.

The sugar pine is the most distinguished and valuable of western pines and far exceeds in dimensions any other member of the family.

Variety *minor*—Little Sugar Pine. Tree and fruit small; bark thin, very finely checked or smooth, and whitish. Northern coast mountains and the Sierra, rare.

GROUP 2. DWARF-CONE, ALPINE PINES.

Dwarfed, often depressed trees, forming the upper fringe of alpine forests in the Sierra and northward. Cones sub-cylindrical or ovate, shorter, with fewer scales, 2–6 inches long. Seeds large, nearly wingless. Bark thinner and lighter colored than the first group.

No. 3. Pinus flexilis, James.—Limber-Twig Pine, Western White Pine.

Trees of the Rocky Mountains, a few in the Southern Sierra about the headwaters of Kings River; often depressed to flat, dense, scarcely yielding platforms. Yearling cones, one inch long, purple. Mature cones, 4–6 inches long. Twigs very flexible, yielding to pressure from snow, ice, and wind.

No. 4. Pinus albicaulis, Engel.—White-Bark Pine, Creeping Pine.

Dwarfed, very white-barked trees of the Northern Rocky Mountains and rare in the high Sierra, notably forming the timber line of Shasta. Year-

ling cones globular, ½ inch long, dark purple. Mature cones small, subglobose, 1½–2 inches long, deep purple until maturity. Seeds pale, nearly globular.

(To this class belongs also *Pinus reflexa*, Engel., of the high mountains of northern Arizona; a tree resembling *P. monticola*, but with thicker cones, the long, spoon-shaped scales of which are reflexed at the apex, the seeds large and nearly wingless like the second group.)

CLASS II. ROUGH-CONED, PITCH PINES.

(SUB-GENUS PINASTER of Botanists.)

Cone-scales rough, armed with conspicuous protuberances, prickles, or hooks. Wood usually darker, harder, more resinous than that of the first class. (Exception: Our thin-bark pine has very white wood.)

Eighteen species on the Pacific Slope, fourteen in California, in two Sections of two Groups each, and an intermediate solitary species.

SECTION A. SUB–TERMINAL, MOSTLY DECIDUOUS–CONED, HARD PINES.

Cones arising near the terminal leaf-bud, and, at maturity, separating from the stem either below or just within the base.

Eleven species on the Pacific Slope, eight in California, in two very unequal groups.

GROUP 3. ENTIRE–CONE, CLOSE–GRAINED PINES.

Cone small, remaining whole at maturity, separating regularly from the peduncle. Leaves short. Male flowers very small; scales 4–6.

Three distinct pairs of species.

FIRST PAIR. OBLONG–CONE, PLUME PINES.

Cones oblong-cylindrical, 3–5 inches long, ½–1½ thick, pendent from the ends of the long branchlets; scales numerous, and nearly flat; leaves mostly in fives—persisting for many years, 10–20, very short and appressed to the branchlets, whence the resemblance to plumes—sheaths loose, deciduous.

Sub-alpine, spire-shaped trees of the Rocky Mountains, with a few groves in the high Sierra. Wood reddish, cross-grained, and exceedingly tough. Bark reddish-brown, deeply fissured.

No. 5. Pinus Balfouriana, Jeffrey.—Fox-tail Pine, Spruce Pine.

Medium sized tree, at a distance suggesting a spruce with its long drooping limbs. A few trees at an altitude of 7,500 feet forming a dark-green belt on the south flank of one of the eastern spurs of Scott Mt., 20 miles west of Shasta, where Jeffrey detected it in 1852 (rediscovered by the writer, in 1878); only other California localities, a few trees near the headwaters of Kings River, in the Southern Sierra. Yearling cones deep brown, ¾ inch long. Mature cones 3–6 inches long, dark purple with small, recurved, persistent (not "deciduous") prickles standing in a depression of the scale; seeds pale, beautifully mottled above with brown; wings an inch long, numerously veined with brown.

No. 6. Pinus aristata, Engel.—Bristle-Cone Pine, Hickory Pine.

Similar but usually smaller trees, 40–100 feet high, and 2–4 in diameter. A few trees only in the Southern Sierra, but more common in the mountains

of Northern Arizona, New Mexico, Nevada, Utah, and Colorado, at 7,000–10,000 feet altitude. Yearling cones purple, $\frac{3}{4}$ inch long. Mature cones shorter but with many more scales than the other species, with prominent scale-tips armed with usually long, incurved or twisted, weak, bristle-like prickles; seeds smaller, paler, with shorter $\frac{1}{2}$-inch, incurved, transparent wings. Generally classified as a variety of the preceding but well entitled to specific rank upon the distinctions named. (See extended description for further remarks.)

SECOND PAIR. GLOBE-CONE, NUT PINES.

Cones sub-globose, $1\frac{1}{2}$–2 inches long, scales few, very protuberant and unarmed, widely opened at maturity. Seeds very large, wingless, and edible. Favorite Indian food. Leaves heavy-scented, with loose deciduous sheaths.

No. 7. Pinus monophylla, Torr. & Frem.—Single-Leaf, Fremont's Nut Pine.

Small, branching trees on the Eastern Slope of the Sierra and southward. Leaves white-glaucous, solitary, round, and spine-pointed. Cones two inches long with hard-shelled seeds. The solitary leaves of this species not elsewhere known in the Pine family.

No. 8. Pinus Parryana, Engel.—Parry Pine, Mexican Piñon.

Trees similar but smaller. On the mountains of Lower California, a few trees crossing the boundary into San Diego County. Cones smaller, with soft-shelled seeds. Leaves in fascicles of 4 or 5.

(To the Nut Pines belong also *P. edulis*, Engle., of New Mexico, similar in appearance and fruit but leaves mostly in pairs; and *P. cembroides*, Zucc., of Northern Arizona, very small trees and small, few-scaled cones, but seeds larger and leaves 2–5.)

THIRD PAIR. THIMBLE-CONE, THIN-BARK-PINES.

Cone very small, 1–$2\frac{1}{2}$ inches long, strongly declined, falling at maturity or persisting indefinitely. Male flowers are very small; leaves in pairs; seeds and wings very small. Trees with exceptionally thin bark and white, soft wood.

No. 9. Pinus contorta, Dougl.—Scrub Pine, Twisted Pine.

Small, scrubby trees in swamps of the northern sea coast. Yearling cones globular, minute, $\frac{1}{4}$ inch long, with pointed, spreading scales. Mature cone sub-cylindrical 1–2 inches long, very strongly declined and long persistent, at length almost concealing the foliage. Seed minute with very small, narrow wing. A curious dwarf pine that would prove ornamental for hedges or in lawns and parks.

No. 10. Pinus Murrayana, Balfour.—Tamarack Pine, Murray Pine.

Usually tall, slender trees in wet sub-alpine valleys of the Sierra and Rocky Mountains. Yearling cones globular, $\frac{1}{4}$ inch long, with pointed, spreading scales. Mature cones ovate-conical, $1\frac{1}{2}$–$2\frac{1}{2}$ inches long, less strongly declined, and usually deciduous. Beautiful trees when in open situations. Bark only $\frac{1}{4}$–$\frac{1}{2}$ inch thick. Trees much attacked by parasites and other enemies, and so discharging resin or pitch, hence often called "Pitch Pines."

(To this Pair is closely connected an outlying species—*P. Banksiana*, Lamb, often confounded with *P. Murrayana*, and found in British Columbia, 150 miles from our boundary. This is the "Gray Pine," of Canada and the Eastern States, with its very small, narrow, persistent cones curiously incurved like little horns in the direction of the apex of the stem—the only cones of this character known.)

Group 4. Base-Broken-Cone, Lumber Pines.

Cone breaking away at maturity by a transverse fracture within the base, rendering it thereby truncate (*i. e.*, cut-away) at the base, and leaving persistent on the limb, its undeveloped, basal scales. The cones are ovate-conical, sessile or nearly so, spreading or slightly declined, many-scaled—5 spirals inclining in one direction, 8 the other. Seeds about ½ an inch long, wings about an inch long, transparent, beautifully veined with brown. Leaves in threes, and 5–8 inches long, sheaths long, close-wrapped, and persistent. Male flowers large and long, scales 10–12. Bark usually very thick and deeply fissured into large sections.

Trees of the largest dimensions, widest distribution, and of the utmost value for lumber, fuel, etc.

One pair of species, each with three varieties.

No. 11. Pinus Ponderosa, Dougl.—Yellow Pine, Heavy Pine.

Trees of the largest size, 120–200, not rarely 250–300 feet high, and 4–10, rarely 15–20 feet in diameter. Headquarters of greatest development in the Sierra Nevada, with marked varieties or sub-species distributed over the mountains of the Pacific Slope, and eastward to the Rockies, and the Black Hills (Dakota), and southward through Arizona and New Mexico to the northern States of Mexico. Bark in the typical form, whitish-yellow, very thick and deeply fissured longitudinally, into large plates, very flakey, but in the varieties darker, thinner, and harder. Sap-wood usually thin, of few layers, whitish; heart-wood correspondingly abundant, yellowish. Yearling cones, green, oval or elliptical, ¾–1 inch long, with pointed, appressed scales. Mature cones conical-ovate 2–5 inches long (slightly truncate at base after falling), of usually a rich brown color, when ripe the scales spreading; prickles small, erect or incurved. Male flowers 2–3 inches long, flexuous, reddish purple.

Variety (*a*) *Benthamiana*, Hartweg—Foothills Yellow Pine: Coast mountains, and western foothills of the Sierra. Usually smaller trees than the typical species with darker, thinner bark, and longer, slim cones green until maturity, then leather-brown.

Variety (*b*) *scopulorum*, Engel—Rocky Mountain Yellow Pine: Rocky Mountains and Black Hills (Dakota). Medium sized trees with darker bark and smaller fruit than the typical. Leaves shorter, often in pairs.

Variety (*c*) *brachyptera*, Engel—Southern Yellow Pine: Highest mountains of Arizona, New Mexico and southward. Trees and fruit medium sized. Bark thinner than the typical and divided into smaller plates. Foliage thin.

(See extended description for remarks upon varieties.)

No. 12. Pinus Jeffreyi, Murray.—Black Pine, Sap-wood Pine.

Similar, but never so large trees as the typical forms of the other species, usually more spire-shaped and symmetrical. In the Sierra, with a variety southward to Lower California. Bark dark, often reddish or black, and hard, fissured into small plates. Sap-wood usually very thick, often composing

the most of the timber, whitish; heart-wood consequently meager, not so light colored as the other species, often very resinous. Yearling cones purple, larger, elliptical, 1–1½ inches long with larger prickles, which are strongly deflexed. Mature cones usually much larger and more truncated, elongated 5–6, often 8–10 inches long, and half as wide when expanded; prickles strongly deflexed, giving one of the early names of the variety. Leaves mostly larger, and with its branchlets usually glaucous, the latter when bruised giving off a fragrance resembling oil of orange (Sargent). Male flowers shorter, 1–1½ inches, but thicker and yellowish. (See extended descriptions.) b

Variety (*a*) *nigricans*—Black-Bark Pine: Timber very sappy. Bark black. Leaves and branchlets glaucous. In the Sierra at low altitudes, often in wet localities. Most common form.

Variety (*b*) *deflexa*, Torr.—Red-Bark Pine: In the Sierra and southward at usually higher altitues, often very large trees. Timber less sappy. Bark reddish. Yearling cones purple.

Variety (*c*) *peninsularis*—Peninsular Pine: On the highest, central range of mountains in the Peninsula of Lower California. Large trees, fruiting abundantly, with large, mahogany-colored fallen cones. Timber qualities unknown.

(The original locality of Jeffrey's discovery is in the regions of Mount Shasta, north and west, the trees being of large size on moraine soil, with large, long, drooping limbs; bark reddish-black and thick; cones very large, elliptical, 8–10 inches long, with numerous scales, dark purple until maturity, then leather-brown, with strongly deflexed (not "incurved") spines. Seeds large, mottled above, with nearly transparent brown-veined wings. This form must be taken as the true type of *P. Jeffreyi*, both on account of its first discovery and also of its first origin in time, on the moraines and exposed slopes soon after the Glacial Epoch.)

To this 4th group (The Broken-Cone Pines) belongs also the lately detected *P. Arizonica*, Engel., of the high mountains of Northern Arizona, a small tree resembling *ponderosa* var. *Benthamiana*, but smaller, with cones 2–4 inches long and its leaves in fives—distinguished principally by the latter character.

SECTION B. MOSTLY LATERAL, PERSISTENT-CONED, COARSE-GRAINED PINES.

Cone lateral, *i. e.*, arising along the bearing shoots usually at some distance from the apex; verticillate or clustered and declined, mostly not falling at maturity but persisting and either becoming inclosed by the later layers of wood, or, the peduncle is stretched and, at length, broken by the enlargement of the tree and the cone is carried outward confined in the bark.

Seven species on the Pacific Slope, six in California, mostly near the coast, in two unequal Groups, a pair and a trio, with a solitary species between them.

GROUP 5. HEAVY, SPINE-CONE, LONG-LIMBED PINES.

Cone of the heaviest, largest, and hardest description, on long, stout, spreading peduncles, opening at maturity and scattering the seeds, but usually remaining persistent until forced off by the enlargement of the tree, then leaving, often, a few basal scales persistent. Scales very large, broad and thick, terminating in long, stout incurved hooks. Seeds large, black, and thick-shelled, edible. Leaves in threes, very long. Male flowers an inch long, scales 10–15.

Picturesque trees remarkable for their usually divided trunk or very long limbs and for their very heavy, spine-bearing cones.

No. 13. Pinus Coulteri, D. Don.—Big-Cone Pine, Coulter's Pine.

Trees usually larger than those of the next species, with dark-green, abundant foliage, found in a few cañons and other sunny localities of the interior coast mountains, from Mount Diablo to Santa Inez and San Bernardino. Leaves, the largest known, 8–14 inches long and ⅔ of a line wide. Yearling cones, 1–2 inches long, with shorter appressed scales. Mature cones elongated, elliptical, of matchless size and weight, 15–20 inches long, half as thick, and weighing 5–8 pounds. The large scales more gradually tapering than the other into the large unexampled, incurved hooks, which on the upper (outer) side near the base are 1½–3½ inches long. The seeds are, quite unexpectedly, smaller, about ½ inch long and one half as wide, but with large broad wings, 1½ inches long.

Well named, but too late, *P. macrocarpa*, by Lindley, the size and weight of the cone being unprecedented. Small forms of this tree may be mistaken for robust specimens of the other, but the characters of the seed given will always separate them.

No. 14. Pinus Sabiniana, Dougl.—Gray-leaf Pine, Sabine's Pine.

Trees of the hot interior foothills with divided or branching habit and usually light grayish, glaucous foliage, which is usually scant, mostly gathered at the ends of the leading, upper shoots, the other branchlets poorly provided with few, weak, at length drooping leaves. Yearling cones globular, an inch long with long spreading, hook-like scales. Mature cones heavy, 2–5 lbs., broadly ovate, 4–10 inches long, the stout hooks abruptly tapering to the point, 1–3 inches long, the longest being at the base on the outer (upper) side. Seed very large, sub-cylindric ½–¾ of an inch long, jet black, with a very thick, hard shell and a delicious kernel, formerly much used for food by Indians, giving this tree the poor name of "Digger Pine." Wings very short, the thick base one-fourth-enveloping the seed with its broad rim.

Intermediate Solitary Species.

No. 15. Pinus Torreyana, Parry.—Torrey Pine, Lone Pine.

A few small trees buffeted, often prostrated, by ocean winds on the bluffs at Del Mar, San Diego County; and a smaller number (about 100) detected the present season (1888) by T. S. Brandegee on the east (the shore end) of Santa Rosa Island, 120 miles north of the other locality.

Leaves in fives very large and long, 8–12 inches. Male flowers yellowish, the largest known; 1½–2 inches long and ¼–⅜ thick, scales 14. Yearling cones globular, ½ an inch long on peduncles 1–2 inches long. Mature cones broadly ovate, 4–6 inches long, and very heavy, 1–2 lbs., with broad, thick scales, armed with short, quadrangular, pyramidal, obtusely pointed prickles. Seeds very large, ovate, sub-cylindrical, ½–¾ of an inch long, the shell very thick and hard, the kernel edible; wings short, very thick at base and encasing the seed like the setting of a jewel. Cones persisting until the 4th season and retaining the lower portion of their seeds, although opened the second autumn preceding.

A singular, very limited, perhaps expiring species, over 50 miles from any other pine, in many respects resembling the historic *Pinus pinea* of the ancients, which has been cultivated from time immemorial.

Group 6. Long-Closed Cone, Slender Pines.

Cones in verticils or clusters of 2–7, often more than one set on the same year's shoot; usually strongly declined, hard, heavy, oblique and gibbous, on account of the outer scales near the base bearing strong knobs or tubercles, but unexpectedly, these not perfecting their seeds; the rest of the scales flat, or nearly so, and bearing the perfect seed. The cones are usually long—persistent, confined in the bark, and *serotinous*, *i. e.*, they remain long closed, retaining the small rough or tuberculated seeds with their vitality unimpaired for an indefinite number of years. Leaves of medium size, 3–6 inches long. Male flowers very small, on branchlets, with leaves above them like the Australian bottlebrush; scales, 6–10.

Small trees, mostly crowded into dense groves, hence, tall and slender; but broad-crowned or rounded if unrestrained.

No. 16. Pinus insignis, Dougl.—Monterey Pine, Remarkable Pine.

Beautiful trees of medium size, extremely local, with headquarters at Point Pinos, on Monterey Bay, and extending along near the ocean from Pescadero to San Simeon Bay, with an outlying variety (?) *binata*, on the Island of Guadaloupe, 600 miles southward. Leaves in threes, rather slender, bright green. Yearling cones an inch long, early gibbous with the enlarged scales. Mature cones ovate-conical, 3–5 inches long, tubercles at base outside large, hemispherical; prickles very small, deciduous. Seeds pale, strongly reticulated with brown; wings an inch long, beautifully veined with reddish-brown. Bark thick, fissured, very hard, black without, bright red on the inner face.

Very interesting trees freely growing upon the but-recently-moving, light sand dunes of the sea. Readily yielding to cultivation and very fast growing, annual layers are often seen ½–¾ and even a full inch thick.

The Monterey Pine has been often classified as *P. radiata*, Don., but this name was founded upon a large coned form, and is, therefore, here used to indicate that variety. (See extended descriptions.)

Variety (*a*) *radiata*, Don.—Spreading-Cone Pine: The large-coned form of Monterey Pine, with shorter, thinner leaves than the typical (Gordon). Mostly southward from Point Pinos.

Variety (*b*) *levigata*—Nearly Smooth-Cone Pine: Cone smaller, and shorter than the typical, and scarcely tubercled. Outlying trees of the Monterey forest, farthest from the sea.

No. 17. Pinus tuberculata, Gordon.—Knob-Cone Pine, Sun-loving Pine.

Usually small, early-bearing, crowded, slender trees, rarely found on dry, sunny slopes of the inner Coast Range and the western and northern hills of the Sierra, where it often attains the height of 40–80 feet with a diameter of 2–3 feet. Yearling cones reddish, ¾ of an inch long, elliptical, with short appressed scales. Mature cones long-conical, pointed 3–7 inches long (shorter and with shorter tubercles in the Shasta region), leather-brown at maturity becoming gray with age, spreading or strongly declined, usually in full verticils, but little removed from each other and persistent on the stems and branches from bottom to top until the destruction of the tree by fire, when the cone-scales open with a loud report, setting free the long-pent transparent-winged seeds, to be carried away by the wind and, perhaps, reforest the region.

No. 13—*Pinus Coulteri*, Don. Big-Cone Pine, San Bernardino Mts., near San Bernardino; altitude, 1,900 feet.

Pair of "Big Cones" (*Pinus Coulteri*), with foliage.
Weight of both, dry and without seeds, 14 pounds; length of each, 20 inches.

The Knob-Cone is often found so small, even when mature (perfecting fruit at 2–3 feet in height) as to receive the name of "Scrub-Pine," but that name is better applied to a tree which is always small and so in this publication used for *P. contorta.*

No. 18. Pinus muricata, Don.—Prickle-Cone Pine, Swamp Pine.

Small, slender trees, rare, in few swampy localities of the outer Coast Range from San Luis Obispo and Point Pinos to Cape Mendocino. Leaves in pairs, but unlike most other binate leaves, very long, 3–6 inches. Yearling cones globular, ½ inch long, with pointed, spreading scales. Mature cones nearly sessile, spreading or recurved, in verticils or clusters of 2–5, often of 6–7, ovate, and slightly gibbous, tubercles longest on the basal, upper side, conical, long, incurved, ¼–½ inch long, all sharp and persistent. Seeds very small, black, with delicate wings. Timber under some conditions said to be hard and tough. The cones have been known to persist 20–30 years and then release good seeds. (See extended description for remarks upon its vernacular names.)

The remaining Pacific Slope pine—*P. Chihuahuana*, Engel.—is a small tree of Arizona, and southward in the northern States of Mexico, having a crooked, decrepit appearance, thick, brown bark, small top-shaped cones, which are nearly smooth and somewhat persistent; the short leaves in threes.

The affinities of this pine are Mexican, and it may not be included in any of the California groups as limited foregoing.

Behavior of California Pines.

The Long-Cone, Lumber Pines

Are embodiments of magnificence, aristocracy, and excellence. Usually large, lofty, and grand, they are also sequestered in choice locations of middle altitudes, admitting to neighborship, but not fellowship, individuals of all sorts, patricians or plebians, but always carrying their aristocratic heads a little higher and holding out their long sugar-loaf rolls of resin-embalmed seeds far above the heads of the smaller, shorter-fruited species.

Trees yielding abundance of unexcelled material alike to pioneer shake-maker and subsequent lumber manufacturer who but levels these noble giants to earth to procure a rich endowment.

The Dwarf-Cone, Alpine Pines

Are illustrations of the daring, aspiring cliff-climbing element in the Pine family. As the beach pines, *Torrey* and *Monterey*, creep or battle their way down to the foam-flecked shore of the sea despite ocean winds or drifting sands, so these short-coned species climb up to, and cling upon the bare steep rocks of alpine peaks, thrusting their flexile stems under the very snouts of glaciers or pressing with might and main through high passes though beaten prostrate the while by wind, torrent, or ice.

The Oblong-Cone, Plume Pines

Are especial representatives of the esthetic, the beautiful, the graceful, in the Pine family. Selecting sequestered, lofty, scarcely-known country seats near the crowned monarchs of the Sierra, embowered by kindred Pine, Spruce, and Fir, they pose on the steep inclines like colossal figures on Nature's easel—exquisite specimens of modern tree-culture, dressed out with emerald garments, waving plumes, and delicate drapery, abounding

in the double-curve, Hogarth line of grace and beauty and but half-concealing their beautiful, royal-purple-hued pendent cones.

The Globe-Cone, Nut Pines

Represent the provident, liberal, yet economical element in the Pine family. Generally found on low hills or sunny, undulating plains, they spread out their strong limbs, heavily laden, in easy reach of the aborigine; the cones being unarmed, few-scaled, and containing comparatively the largest, most delicious, and nutritious seeds of any other trees of the family.

The Thimble-Cone, Thin-bark Pines

Are the plebeian, unobtrusive, impoverished unfortunates of the Pine family. With attenuated, thin-barked trunks attacked at all stages by parasites and other enemies, both vegetable and animal; their bleeding bodies, and often bare, gnarled, and twisting limbs excite commiseration, which, however, is dispelled in the presence of a heroic individual that has turned the tables on his enemies, or succeeded in resisting their attacks, and so presents a full, crowned head of robust foliage.

The Broken-Cone, Lumber Pines

Comprise the profuse, cosmopolitan utilitarians of the family of Pines. With forms innumerable and individuals widely distributed, they have developed the most adaptable and useful qualities, both in behalf of mother nature, in clothing with forests large sections of country, and of man in furnishing most valuable and procurable lumber and fuel-producing factors of civilization.

The Intermediate Lone Pine

Is perhaps a vestige of a once vast forest occupying a region now mostly submerged; or these singular trees may be precursors of a coming, aggressive, conquering species destined to reforest the southern coast hills.

The Heavy, Spine-Cone, Long-Limbed Pines

Present the ponderous, massive, and coarse, also the protecting and defending principles in the multifarious Pine family. Inhabiting hot, scorched regions, contending there with dwarfed oaks and chaparral, these trees are never slim and feeble, but rather broadened out and freely branching, ever holding aloft their enormous clusters of fruit. What end is subserved by the exceeding massiveness and the formidable armament of their cones? That it is a special adaptation of conditions to environment, of armament to the needs of battle, we may be sure. Doubtless a thick, strong, hard investment of capillary scales defends the ovules from intense heat better than a light one would protect them. Then, too (for there's no end of speculations in this direction), it may be these scales are a defense against the attacks of insects that infest and render abortive the seed crops of other soft-scaled pines and the spruces. And the enormous hooks of their cones, do they not defend against the attacks of nut-hunting squirrels, which else might abridge the dissemination, if not compass the extinction of the race?

The Closed-Cone, Slender Pines

Are the aggressive, conservative, self-sacrificing but surely propagating group of the wonderful Pine family. They are strategical warriors from

away back. Obstreperous and tenacious, they intrude upon coveted ground and multiply upon it so numerously that they starve out all other trees and are obliged to stand close together, crowding and fighting, content to be squeezed to slim saplings if only they succeed in lifting but a scant spire of foliage to the sunlight and the wind-gust, in order to elaborate sap enough to bring to perfection their many belts of suspended, curious, wooden, sculptured seed-caskets of long-preserved life-germs, to reforest the region upon occasion.

CALIFORNIA PINES.

EXTENDED DESCRIPTIONS.

CLASS I. SMOOTH-CONED, WHITE PINES.

(SUB-GENUS STROBUS of Botanists.)

Cone-scales smooth, devoid of protuberances, prickles, or hooks; wood usually lighter colored, softer, and less resinous than that of the other class. (Exception: Our Sugar Pine is often very resinous.)

Cone, sub-terminal, mostly long-peduncled and falling at maturity; scales, usually numerous and flat; leaves, short, 2–3 inches long, in fascicles of fives each, with short, loose, deciduous sheaths at the base. Male flowers oval, small, $\frac{1}{4}$–$\frac{1}{2}$ inch long.

Five species on the Pacific Slope, four of them in California, arranged in two groups of a pair each.

LONG-CONE PINES.

GROUP 1. LONG-CONE, LUMBER PINES.

Cone long, cylindrical, 8–20 inches long, and 1–3 inches thick, many-scaled, long-peduncled, becoming pendent. Principal spirals, 8 inclining to the left, 13 to the right. Seeds large, dark, with long, brown, persistent wing. Trees usually very large, with finely-checked bark, large and long upper, bearing limbs and light-green foliage. Timber of the utmost value for lumber.

MOUNTAIN PINE.

No. 1. Pinus monticola, Douglas.—Mountain Pine, Finger-Cone Pine.

Compared with the other the MOUNTAIN PINE (here called also the FINGER-CONE PINE) is always found at higher elevations and is much less lofty and extended than the great sugar pine. Like the other species it is greatly given to variation. Trees are found with deeply furrowed, reddish or even dark bark, and long purple cones nearly a foot in length. All grades of condition connect to small spindling trees of higher altitudes, with smooth, silver-white bark, and diminutive cones, like ladies' fingers. The timber, but rarely cut for lumber as yet, on account of inaccessibility, is of marvelous purity and beauty. Clear white, with but little resin, and considerable toughness, it makes good finishing lumber, and works well for walls and ceilings.

When occupying clear spaces the trees may retain their body limbs to full age, and also grow large without much increasing their height. Specimens of Mountain Pine from such a tree—only 120 feet high, but 6½ feet thick and 510 years old—were sent from the vicinity of Webber Lake to the Centennial Exhibition.

Variety, *minima*—LITTLE MOUNTAIN PINE.

On the northern cross-ranges and on the coast mountains grows a dwarf variety of this species that is small and often very slender, with diminutive cones, which further examination may show, entitling the form to rank as a species.

The bark is very thin, smooth, and white. Cones purple until maturity, and but 2 or 3 inches long. Seeds minute. Until more definite information is gained concerning this little, apparently dwarfed *monticola*, it may bear the above varietal name.

GREAT SUGAR PINE.

No. 2. Pinus Lambertiana, Douglas.—Sugar Pine, Gigantic Pine.

The GREAT SUGAR PINE is the accepted, the crowned prince of the Pine family. Not only by virtue of its unexcelled dimensions and the magnitude of its cones is it regal, but it is a most kingly monarch in its majestic, lofty bearing, its erect, self-asserting dignity, and its bowed head, obedient to its only master—the powers above. Only the supreme emperor of the whole vegetable world, the immense *Sequoia*, also a denizen of our great Sierra forest, and admitting the Sugar Pine to fellowship, excels in dimensions (every way but in fruit) this noble, dominant tree of the whole length of the Sierra with but one other giant—the stately Douglas spruce, also a near neighbor—that at all approaches it in vast proportions or majestic appearance.

We can well imagine the ecstacy of delight and excuse the mild self-gratulation with which David Douglas, the discoverer of this noble tree, writing from the falls of the Columbia, March 24, 1826, to his friend Dr. Wm. Hooker, of London, inscribes:

"I rejoice to tell you of the discovery of a new species of Pine, the most princely of the genus, perhaps even the grandest specimen of vegetation known."

After describing its tall stem and its umbrella-like head, its long, outstretched upper limbs, with long cones pendent from the ends, he adds: "Growing trees of this Pine" (he always spells the name of this tree with a capital P), "which have been partially burned by the Indians, produce a substance which they use largely, and which I am almost afraid to say *is sugar.*"

In another letter addressed to Dr. Scouler he writes: "This is unquestionably the most splendid specimen of American vegetation known. What would Dr. Hooker give to dine under its branches? As for Mr. Lambert" (for whom he had named the tree the August preceding), "I hardly think he could eat at all."

The SUGAR PINE being the crowning discovery of Mr. Douglas—five other of our pines having rewarded his indefatigable search—it is pertinent to give in this connection extracts from his journal describing his adventures in pursuit of this pine; the procuring of the cones of which at the very last, nearly cost him his life.

DOUGLAS' SEARCH FOR THE SUGAR PINE.

August 19, 1825. Mr. Douglas, who had been exploring the upper country of the Columbia, started from his headquarters at Vancouver to proceed southward, ascending the Multnomah towards the mountains at the extreme (south) end of the Willamette Valley.

After a perilous three days' trip he reaches the natives of the region and "finds in their tobacco pouches seeds of a remarkably large size, which they eat as nuts," and which he knew to be pine seeds. He learns that the tree grows on the mountains to the south—that is, down nearly to the present California line.

"No time was to be lost," he writes, "in ascertaining the existence of the tree," which he at once, with only a few imperfect seeds in hand, names *Pinus Lambertiana*, in honor of his friend, Aylmer Bourke Lambert, the distinguished Vice-President of the Linnæan Society of England. But sickness and inclement weather, also Indian hostilities, prevented further search southward for that season. However, he explores other regions eastward, discovering two new species of pine, which he names *Pinus nobilis* and *Pinus amabilis* (now well known firs, but then included in the genus of pines), making headquarters for the winter at Fort Vancouver.

During the spring and summer months of the next year, 1826, he makes various extensive journeys, rewarded constantly by important discoveries, for the country was all unknown then.

In February a hunter brings him a cone of his Multnomah pine. It "was 16½ inches long and 10 in circuit," and he was assured that "trees were met with that were 170–220 feet high, and 20–50 feet in circumference."

In June, while at the junction of the Lewis and Clarke Rivers, he planned a long trip southward to the Umpqua River, in search of "the gigantic pine," but could not get off in that direction until October. On the eighteenth Douglas, with a companion, "set off due south through the dominions of the Chief, Center-Nose, and having climbed wearily a high divide, we were cheered by the sight of the broad Umpqua River in the valley far below."

A raft was necessary for crossing it, and in its construction Douglas "grievously blistered his fingers." He is also attacked by a severe pain in the chest, almost disabling him from traveling. He creeps along by the aid of his gun and a staff for a time, and is then assisted to travel by a chance-met hunter, who conducts him to his humble camp, where Douglas "bled himself in the left foot, drank a little tea, and soon felt better."

October twenty-third they reach the headwaters of the Umpqua, guided by the son of old Center-Nose, and still "intent upon finding the Grand Pine so frequently mentioned in my journal."

October twenty-fifth.—"Last night was one of the most dreadful I ever experienced. Rain fell in torrents, accompanied by high wind that rendered it impossible to keep a fire burning. The tent was soon blown down about my ears, so that I was forced to lie until daylight in wet blankets, with only *Pteris aquilina* for a bed.

"Sleep was impossible. Every few minutes trees on all sides of the camp came down with a crash, while the flashes of forked lightning and the peals of thunder gave me such terror as had never filled my mind before. Even my poor tired horses were unable to endure the hardships without craving protection, which they did by cowering close to my side, hanging their heads over me, and neighing wildly."

At daylight he "rubbed himself before a fire to restore vitality," and when he had become nearly restored he "was suddenly seized with intense pains in the head and stomach, accompanied by giddiness and dimness of sight," all of which he strove to relieve "by throwing myself into a perspiration by violent exercise."

Early in the morning of the same day (October twenty-fifth) Douglas quitted camp, and "after an hour's walk met an Indian, who, on perceiving me, instantly strung his bow, then slung his raccoon skin of arrows upon his left arm, and stood on the defensive. Being quite sure that he was not hostile, but prompted by fear only, I laid my gun at my feet and beckoned him to approach me, which he did slowly and with many precautions. I then made him place his bow and quiver beside my gun, and, striking a light, gave him a smoke out of my pipe. Then with pencil and paper I drew a rough sketch of the cone and tree which I desired to find, and exhibited the sketch to him, when he quickly pointed towards the hills, fifteen or twenty miles distant, and southward."

Hastening on, at midday Douglas "reached the locality of my long-wished-for pines, and lost no time in examining them, and endeavoring to collect twigs, specimens, and seeds.

"New and strange things," Douglas pauses here to remark, sententiously, "seldom fail to make strong impressions, and are, therefore, often faulty or overrated; so, lest I should never again see my friends in England, to inform them verbally of this most beautiful and grand tree, I shall here state the dimensions of the largest found among several that had been felled by the wind.

"At three feet from the ground its circuit was fifty-seven feet nine inches (that is, nearly nineteen feet in diameter). At one hundred and thirty-four feet it was seventeen feet five inches. Extreme length, two hundred and forty-five feet. The trunks are uncommonly straight, the bark smooth, the tallest stems unbranched for two thirds of their height, the branches outreaching or pendulous, with long cones hanging from the points like sugar loaves in a grocer shop.

"The cones are borne only by the largest trees, high suspended in air, and the putting myself into possession of three of them, all I could procure, nearly brought my life to a close.

"As it was impossible either to climb the trees or to hew one down I resorted to knocking them off by firing at them with ball. The report of my gun almost instantly brought into view eight Indians, all armed with bows, bone-tipped spears, and flint knives. I endeavored to explain to them what I was doing there and what I wanted, and they seemed satisfied, sitting down to smoke with me; but presently I perceived one of them to string his bow, and another to whet his knife with a pair of wooden pincers. Further testimony of their intention was unnecessary.

"To save myself by flight was impossible, so without hesitation I sprang backwards about five paces, cocked my gun, drew one of the pistols from my belt, and showed myself determined to fight for my life.

"As much as possible I endeavored to preserve coolness, and thus we stood facing each other without the slightest movement or uttering a word for full ten minutes. At last the leader dropped his hand and made signs for tobacco and pipe. I signified that they should have a smoke if they would fetch me a quantity of cones. They went off immediately, and no sooner were they out of sight," says Douglas, "than I picked up my precious cones and made the quickest possible retreat."

Poor Douglas never saw his "Grand Pine" again, and upon his second tour of western exploration the next season, after visiting Monterey Bay

and vicinity, where he discovers *Pinus insignis* and *P. Sabiniana*, he sailed for the Hawaiian Islands, and while exploring there he fell into a pit prepared for capturing wild cattle, and was trampled to death by an entrapped steer.

Description.

The GREAT SUGAR PINE excels in evenness and straightness of grain, hence making excellent timber for riving into shakes or shingles, and this quality has led already to the shameful destruction of thousands of noble trees on Government land. Lawless vagabonds penetrate the Sierra forests, with only the equipment of an ax and a long saw, and leveling these monstrous trees they saw out a cut, examine it, and, perchance, move on to the destruction of others, leaving to rot on the ground trees that would yield to the careful lumberman twenty thousand to fifty thousand feet of clear lumber worth hundreds of dollars.

A peculiarity of this pair of trees is the specialized, long upper limbs and the short lower ones, which soon decay and fall; thus the trees, self-trimmed while yet small, swell out their matchless trunks with smooth bolls reaching up to the great limbs, affording the longest clear-cut lengths for saw logs of any tree known. I sent to the Philadelphia Centennial Exhibition, in 1876, specimens from a tree in Sierra Valley, Sierra County, that was one hundred and seventy-five feet high, seven feet in diameter, and five hundred and eighty-eight years old. It was estimated to yield seventy thousand feet of clear lumber. Trees are met with in the sugar pine regions of the Southern Sierra that rival in dimensions the twenty-feet tree described by Douglas.

As stated, this pair of species are never found forming a grove of even small size exclusively; they always mingle with others, or what may be a more consecutive statement of the truth, they freely admit other trees of all sorts and conditions to neighborship. But whatever the company they keep, only these monsters, the sugar pines, rising like columns of light in the forest, are companions of each other.

The SUGAR PINE varies greatly with altitude and exposure, also there may be a radical difference in the source, the origin of certain forms, which careful study of numerous subjects may yet detect. Oddly enough, trees in contiguous forests will exhibit often wide differences in various ways; the yearling and immature cones of the second season will be deep purple on one collection of trees, these usually on higher locations; and yellowish with shorter cones than other larger trees below bearing longer, apple-green cones.

Variety, *minor*–LITTLE SUGAR PINE.

Trees and fruit, small; bark, thin and whitish, often quite smooth and unchecked. Found rarely on the northern cross-ranges and in the coast mountains. Until further studied it may bear the above name.

ALPINE PINES.

GROUP 2. DWARF–CONE, ALPINE PINES.

Dwarfed, often depressed trees, forming the upper fringe of alpine forests in the Sierra and northward. Cones, sub-cylindrical or ovate, shorter, with fewer scales, 2–6 inches long; seeds, large, nearly wingless; bark, thinner and whiter than the first group.

Group 2. Short-Coned, Alpine Pines.

No. 3. Pinus flexilis, James.—Limber-Twig Pine, Western White Pine.

No. 4. Pinus albicaulis, Engel.—White-Bark Pine, Creeping Pine.

As the beach pines—Torrey pine and the Monterey pine—resist the storms of ocean and hold to the loose drifting sand of the coast, even creeping down to the very foam of the sea, so the alpine members of this family, the Limber-Twig Pine and the White-Barked Pine, climb up to and cling stoutly to the bare, bold rocks of the alpine peaks, and thrust their flexile stems under the very snout of the glaciers, or they grope resolutely, though prostrated by torrents and gales, along the glacier-smoothed passes of the Sierra.

Here is a most marked example of the adaptation of subject to environment. None but a flexible nature could do battle victoriously against such odds. How long before the brittle stems and long leaves of the foothill pines would be snapped and scattered over the mountain side where these crouching supple-stemmed species battle and annually celebrate their victory by the production and dissemination of a proportionately larger amount of seed than do other species of the mild, soft, enervating lowlands.

These alpine species, though differing in minor details of fruit and stem, closely resemble each other, as might be expected when comrades, brothers of the same family, are compelled to face and fight similar dangers.

It will be noticed, first, that the fruit of the alpines is shorter and much smaller than that of their nearest kindred before described. This is but adaptation of condition to needs.

A small, nearly globular cone 2–3 inches long, set closely upon its short, thick stem, can tide out a storm better than a cone of 20 inches hung out on a long, swaying limb.

Secondly, the timber of the Alpines is exceedingly tough. I doubt if a species of other groups will discover a tithe of the toughness that these trees possess if they could be sufficiently examined. Naturally, their locality away up to the timber line almost precludes the possibility, at least the ready probability, that characteristic specimens have ever been tested for strength. I know the subalpine Plume Pines are credited with exceeding toughness, and, no doubt, proper tests of them have been made. But the fact of the superiority of the endurance of the Alpine Pines may be postulated upon the bare proposition that they *need* to be tough—and so they *are* tough.

I have had frequent occasions to test the strength of the limbs of these species by seizing them, never without safety, in enabling me to pull myself up a precipice by their overhanging boughs.

About the peaks of the alps back of Yosemite, I have often had occasion to notice the strength, the slowness of growth, and the extreme age of very small specimens of these trees. Tourists in these heights have tied the young shoots into knots years ago, yet the trees are thriving.

John Muir says of *P. flexilis:* "A certain tree that was 3½ inches in diameter and hardly 3 feet high, when cut half way through, revealed no less than 250 rings. Another similar one was 420 years old; one of its small branchlets, hardly half an inch thick, displayed 75 rings, and was so filled with balsam and so seasoned in storms that we may tie it in knots like whipcords."

But few have enjoyed what it was the writer's privilege to experience while exploring the upper heights of Yosemite. I climbed Anderson's rope

No. 10.—*Pinus Murrayana*, Balf.—Tamarack Pine, Donner Lake, near Truckee.
Alt. 5,800 feet.

(now both the rope and its intrepid maker in dust) to the top of South Half-Dome.

Exploring its crown we found an ellipse of table rock about one hundred rods long, with but one tree maintaining its hold, as by an eagle's talons, to the wind-swept rock, two miles in vertical height above the sea. Of course it was the LIMBER-TWIG PINE, over two feet thick at base, but only a few in height, with willowy branches that receded and swayed, self-protectingly, with every breeze.

Comparing this pair of species with their well-known and gigantic twin brothers, the contrast is of the widest degree. The GREAT SUGAR PINE and the MOUNTAIN PINE are the tallest of the family; these alpines often spread their platforms of foliage but a few feet above the rocks; those with long, out-reaching limbs, with half-yard long pendent-cones in playful dalliance, these with contracted, flexuous branches conformed to the furrowed rocks, while nestling close to their leafy couches the diminished, but precious progeny of cone and seed; those furnishing their seeds with long wings to carry them sailing on the wind to distant localities, these stripping their seeds of such destructive organs and sending the plump, pale seeds to drop at once into a favorable rock cleft.

Comparing them one with the other, the LIMBER-TWIG is often found with a considerable show of trunk and length of limb, the others never but little of each; the first, with limber branches, avoids injury from attacking objects by gracefully yielding the path, the WHITE BARK resists encroachment with sturdy, short thick branchlets.

The flowers of these pines are exceptionally pretty, being large spikes o rose-red stamens, set off with tufts of the short leaves beneath them. The seeds of the WHITE-BARK PINE are the favorite food of Clark's crow, and for several seasons scarce an uninjured cone or a ripe seed have I been able to procure by reason of the previous visitation of this pine crow to the Shasta timber-line trees.

A curious formation in the male flowers of this last species I should record in this connection, as it may foreshadow a line of development that will bear investigation and prove of interest. On a tree of the WHITE-BARK PINE, growing near the trail and about one half mile below Horse Camp, at the timber line of Shasta, was detected in September, 1888, a great many beautiful reddish flowers in short spikes. On close examination each spike of stamens was noticed to be forked near the base, the separated parts continuing to the end about one half inch.

Among scores of blossoms examined not an exception was detected, and I have thought it best to preserve several specimens between two slides of thin glass for the benefit of any student who desires to examine the phenomenon.

In this connection it may be stated that the involucral scales of the various male flowers of our species, as also bits of seed-wings and cross-sections of leaves, have all been prepared and placed under thin glass slides for microscopic examination.

CLASS II.—ROUGH-CONED, PITCH PINES.

(SUB-GENUS PINASTER of Botanists.)

Cone-scales rough, armed with conspicuous protuberances, prickles, or hooks. Wood usually darker, harder, more resinous than that of the first class.

Eighteen species on the Pacific Slope, thirteen in California, in two sections of two groups each; and an intermediate solitary species.

SECTION A. SUB-TERMINAL, MOSTLY DECIDUOUS-CONED, HARD PINES.

Cones arising near the terminal leaf-bud, and at maturity separating from the stem either below or just within the base.

Eleven species on the Pacific Slope, eight in California, in two very unequal groups.

GROUP 3. ENTIRE-CONE, CLOSE-GRAINED PINES.

Cone small, remaining whole at maturity, separating regularly from the peduncle. Leaves short. Male flowers very small.

Three distinct pairs of species.

PLUME PINES.

FIRST PAIR. OBLONG-CONE, PLUME PINES.

Cones oblong-cylindrical, 3–5 inches long, ½–1½ thick, pendent from the ends of the long branchlets; scales numerous, and nearly flat; leaves mostly in fives, persisting for many years, 10–20, very short and appressed to the branchlets—whence the resemblance to plumes—sheaths loose, deciduous.

Sub-alpine, spire-shaped trees of the Rocky Mountains, with a few groves in the high Sierra. Wood reddish, cross-grained, and exceedingly tough. Bark reddish brown, deeply fissured.

The sub-alpine Plume Pines are very interesting trees, at first sight seeming not to be pines at all, but spruces from the similitude of their close-clothed limbs and small, depending cones. They are so high in the alpine forests that only the hunter or explorer is apt to know of them, and hence, perhaps, some errors have crept into former descriptions.

Both are usually found in loose, volcanic or moraine soil, on steep inclines.

FOX-TAIL PINE.

No. 5. Pinus Balfouriana, Jeffrey.—Fox-tail Pine, Spruce Pine.

This singular spruce-like pine exhibits an instance of extremely limited and local development. As shown by the "Descriptive List," it is only found in a few groves of the alpine Sierra, from Scott Mountains to the headwaters of Kern River. The Scott Mountain locality was discovered in 1852, by that sharp-eyed Scotch gardener, John Jeffrey, representing Edinburg florists, and sent out to explore more thoroughly the new forest of rare trees, of which Douglas had reaped such a rich harvest.

Jeffrey noted his discovery "Mountains between Shasta and Scott Valley, N. Cal. Lat. 40° 30′ to 41° 50′. Elevation 5,000 to 8,000 feet. Trees, 80 feet high by 3 in diameter." All of which, with his minute description, was published by the "Oregon Committee," from which I have taken the above items, derived from a rare copy in possession of Dr. Parry. But so small are the groves, and so local their position, they were not detected anew until August of 1878, when the writer, making his headquarters at Sisson, prosecuted a thorough search of the various intricate mountain ranges lying west of Shasta, and forming spurs of the diversified Scott

Mountains. I noted the locality for publication in "Brewer's Botany of California," as "on the southern flanks of the Scott range of mountains, forming a dark-green belt, from 5,000 to 8,000 feet altitude, between the light-colored *P. monticola* below and *P. albicaulis* above it." Mr. Sisson has since guided Professor Sargent, Dr. Engelmann, Dr. Gray, and Sir Joseph Hooker to the locality, for the purpose of their studying this curious tree.

In "Botany of California" the description occurs "*apophyses*" (that is, the exposed portion of the cone-scales) "thick with short deciduous prickles;" but I find the part of the cone-scale described is thin, the little recurved prickle standing in a depression and by no means "deciduous," but firmly persistent.

BRISTLE-CONE PINE.

No. 6. Pinus aristata, Engelm.—Bristle-Cone Pine, Hickory Pine.

This beautiful tree, also a lover of alpine heights, though somewhat common on the highest peaks of the Rockies and the mountains of Arizona, is quite local in California. I have only detected it in the high Sierra back of Yosemite, and upon Mount Agassiz of Northern Arizona at an elevation of about ten thousand feet.

John Muir writes of the bristle-cone pine: "Grows on the headwaters of the Middle Fork of Kings River, how much further north I cannot say, but certainly it extends southward to the extremity of the range. It reaches its highest development at elevations of about ten thousand feet in sheltered valleys, or coarsely ground moraines or fissured table lands, and runs up to the limit of tree life on the summit. It combines gracefulness of habit with strength and flexibility in a marvelous manner. It is certainly the most variably graceful of all the Sierra pines."

VARIETY OR SPECIES, WHICH?

The Bristle-Cone Pine when first discovered was given specific rank by Dr. Engelmann and so classified for some time, but other discoveries, subsequent, led the doctor to regard it as but a variety of *Balfouriana*. They differ mainly upon characters of the fruit (see description of both species in Descriptive List). I have not hesitated to give *aristata* specific rank not only upon the distinctions noted, but for other considerations. It seems to me absurd, that because Jeffrey discovered near Shasta a little, outlying grove of peculiar trees, in 1852, several years before other botanists discovered many other forests of somewhat similar trees, widely distributed over the mountains of Colorado, Utah, New Mexico, Arizona, and the southern Sierra, that, *therefore*, his little grove should be regarded as the type of a species and all the rest added to it—the first instance we have to deal with of adding a many-roomed house to a single-roomed annex.

GLOBE CONE PINES.

Second Pair. Globe-Cone, Nut Pines.

Cones sub-globose, 1½–2 inches long, scales few, very protuberant and unarmed, widely opened at maturity. Seeds very large, wingless, and edible. Favorite Indian food. Leaves heavy-scented, with deciduous sheaths.

SINGLE-LEAF PINE.

No. 7. Pinus monophylla, Torr. & Frem.—Single Leaf, Fremont's Nut Pine.

This curious little SINGLE-LEAF PINE has been met with in several places on the eastern and southern slopes of the Sierra. Perhaps its headquarters of greatest development are in the Tehachapi Mountains, where Fremont detected it again in March, 1845, having first discovered it the season before near the site of the present city of Carson, as he was about to find a pass through the Sierra near Lake Tahoe. Fremont noticed this pine with great care for some three hundred miles along his course on both sides of the Sierra. He noticed its resistance to cold, and recorded the fact that in its highest locality the trees were covered four feet with snow, and the mercury stood at -2 degrees. Fremont called it "one-leafed pine;" Endlicher changed it in honor of the discoverer to *P. Fremontiana*, and the tree has ever since bore both of these names interchangeably; but the better name is *P. monophylla*, since it is the only single-leaf pine known.

The trees in open situations, as upon the low hills near Carson, Nevada, become round headed, freely branching from the base, but in the gulches of the Sierra they are spire-shaped, or even tall and slim. Trees in the Tehachapi Mountains were noted in June last four feet in diameter and nearly one hundred feet high.

But the trees of the Sierra are generally decrepit and much broken by winter storms. In sheltered situations beautiful trees are seen of pyramidal outline, often heavily fruited, so heavy that their limbs are bowed to the ground. The cones are usually quickly deciduous. A fine forest of SINGLE-LEAF PINE is found on the San Bernardino Mountains, near Bear Valley, of the same character and condition of bearing as in Tehachapi. Male flowers, June fifteenth, were just disseminating their pollen. Formerly the nuts of this pine were collected in great quantities annually by the Washoe tribe of Indians, for food.

At the harvest time, nearly the whole tribe, men, women, and children, with their ponies, would proceed to the groves of trees and camp by them. With long poles the cones were beaten off by the men, the boys climbing such trees as admitted of it, to secure the fruit, which was taken by the squaws, piled in heaps with leaves and earth thrown over them, and then set on fire.

When roasted several hours the cones will be found opening and discharging the large and truly delicious kernels.

ARE THE LEAVES REALLY SINGLE?

There has been much discussion ever since the discovery of this tree upon the characters of its leaf, and eminent authorities have held opposing views; some declaring that the leaves were truly single and solitary, others that the terete foliage was due to the firm agglutination of a pair of leaves.

Sir Joseph D. Hooker adopted the connate theory, and says:

"The anomaly of the single-leaf is due to the cohesion of the two semi-terete leaves of each sheath, and is far from being a constant character. In the plants at Kew," he adds, "the two leaves are as often free as united, and on making a transverse section it will be seen that the vascular bundle in the center of the cylinder is, in fact, double, and that the two parts are sometimes separate."

Maxwell F. Masters, editor of the "Gardener's Chronicle," London, in "Annals of Botany," Vol. II, No. 5 (kindly loaned me by Professor

Greene), discusses the phenomenon very plainly, and, as he arrives at a different conclusion from the above eminent authority, it will be of interest to present his statements briefly in this paper. After stating that "the axial or ramial nature of the typical pine needle is now pretty generally discredited," he writes:

"In the hope of reconciling the discrepancies between these statements, or of ascertaining which is the nearest to truth, I have recently repeated some observations first made in 1883, both as to the minute anatomy of the leaves and to their mode of reproduction." Then follows a detailed description of the microscopic organs seen in a cross section of a leaf of the *Pinus monophylla*, showing that the structure is in all respects the same as in the leaves of other pines; "hence," he concludes, "the leaf-like body is a *true leaf* which occurs singly usually, but occasionally in pairs, as must have been the case of the leaves examined by Sir Joseph D. Hooker. There is, of course, no difficulty in understanding the latter condition; the anomaly consists in the single cylindrical leaf, to all appearances occupying the apex of a shoot.

"To clear up this anomaly I investigated the development of the constituent parts of the leaf bud at various stages of growth, and, without going into details, I may say that development supplied the clue which neither outward morphology nor internal anatomy sufficed to give. In point of fact, in the earliest stages examined there were always two foliar tubercles, one of which speedily overpassed the other, so that ultimately all traces of the second leaf were obliterated. The monophyllous shaft of this pine," Mr. Masters concludes, "therefore owes its peculiarity to the generally arrested development of one of its two original leaves."

PARRY PINE.

No. 8. Pinus Parryana, Engelmann.—Parry Pine, Mexican Piñon.

[From the San Diego Bee, March 11, 1888.]

BEAUTIFUL PIÑON PINE.

Pinus Parryana.—A Pilgrimage Undertaken for Its Rediscovery.

"What is the next rarest California pine to be studied?"

"Parry's, of San Diego County."

"But that species runs over into Mexico, does it not?"

"Yes, and we will follow after it."

There are some eighteen species of pine in California, a few of them widely distributed into other regions, but most of them quite local. The most interesting in this respect is Torrey's pine, limited to a few hundred trees at Del Mar, which we studied a fortnight ago.

The next rarest species is the piñon or nut pine of San Diego County, named botanically *Pinus Parryana*, in honor of the veteran botanist, Dr. C. C. Parry, who first discovered it during the survey for the Mexican boundary in 1848. The species is sparsely found on the Cuyamaca Mountains in San Diego County, but extends along the highest points of the vertebræ of Lower California.

On the San Rafael group, some sixty miles east of Ensenada and at an elevation of five thousand feet, it is said to be found in its best state.

As we wished to study it under all conditions of environment, we resolved (my husband and I), to first visit its apparent headquarters. All roads

lead to Rome, and most Mexican outlets are by way of the brave, battling border town of San Diego.

On May Day morning we found ourselves smoothly gliding into the famous Todos Santos Bay, past the little islet that helps to break the force of the Pacific when it belies its name, and soon making fast to the long wharf leading to the town of over one thousand five hundred inhabitants, grown from a few Mexican haciendas in a few months, the impetus given to settlement, consequent upon the concession of the upper and best portion of the peninsula, by the Mexican Government, to the International Company of English and American capitalists.

Expressing our desire to a representative of the International Company, an appreciation of the importance of our work brought ready response; but we must not be sent off to the woods that day. No, no. One day must be given to Ensenada and its people.

Next morning a noble span of sorrels, a strong light wagon, with a skillful driver, were placed at our disposal, our camping outfit of tent, blankets, and food supplies were brought out from the Custom House, to which were added our photographic apparatus and botanical equipments, and away we sped for the mountains at a rate surprising to the occupants of the Mexican capital.

Six miles of meandering through a narrow valley, frequently crossing a stream of pure, cool mountain water, shaded by large evergreen oaks, rising successively over mountain spurs, brought our vehicle to the top of the first summit, where, turning our gaze westward, the broad valley, the shimmering bay, the cosy town, and the fringing islet on the horizon, form a most pleasing panorama. Eastward alps on alps rose before the vision, as if to debar further progress, but onward passes the well traveled road, and we pursue, while the valley broadens in places to parks of oak, rich meadows, and most favorable locations for orchards and vineyards. From the first the way was bordered with plants, flowers, and ferns of vigorous growth and lovely appearance. Many were strangers, and awoke covetous desire, but the most were common to the bordering northern regions, though always more robust, the colors of deeper, darker tints. The noon halt was made in a very paradise of beauty; broad-crowned oaks shielded the sunlight, hung with festoons of clematis, through which gleamed vistas of meadow, waterfall, flower carpeted slopes, and bars of tropic sheen. In a twinkling the coffee and eatables are prepared, the former being boiled on an improvised stove made from an oil can, prepared by cutting out both ends and kindling a fire within—a most convenient, cleanly, and expeditious stove, recommended for campers' uses and tested by the writer for the past eight years during extensive explorations.

Seven miles further of more rugged and rocky highway along Los Cruces Valley, bright with parterres of lilies, and revealing moist rock clefts, caulked with rare ferns, and we ascend the last hill and look over into the wonderful San Rafael Valley, twenty miles long and ten miles wide, through the center a river, its winding course indicated by cottonwoods, with frequent lagoons and tule meadows proving the abundance of water. The floor of the valley is a checkerboard of grain fields, squares of freshly plowed grounds, bosses of green shrubbery and alfileria patches, while beyond, a thousand feet higher, rose the delectable San Rafael Mountains, showing at this distance a fringe of pine peeping over their passes, a sight that gladdens our botanic souls and sends us into the little Mexican town of Real del Castillo with happy hearts to pass the night.

With the morning light our spirited sorrels again whirled us out of the sleepy town and across the valley to the foothills. Little had we inquired

or been told what the lofty San Rafael Mountains had in store for us, and our surprise was most genuine when we began winding up through tree-lined ravines that broadened into wide valleys and parks of noble pines that vie with those of the California Sierras, both in beauty and value. Trees were noted four to six feet in diameter, and thirty to fifty feet to the first limbs.

For fifteen miles we glided along amidst the forest over a smooth, hard road of comminuted white sand rock, affording extensive meadows of grass and clover, which but sparsely showed the presence of cattle and horses.

The pines, while most interesting of themselves, and most unexpected, were nevertheless familiar, being the black pitch pine, or botanically, *Pinus Jeffreyi*, variety *peninsularis*, of California, the typical form being very abundant in the forests of the high Sierras, where it is manufactured into lumber. It is to be hoped that this San Rafael forest, so rich and valuable, may be protected from the waste and wanton destruction that marks the progress of the northern timber-cutter.

But we were searching for the little, rare piñon pine, belonging to a group that inhabit only rocky peaks, and the sun had nearly set before the first trees were detected, near Hanson's ranch and the large lagoon beyond it. Pitching our tent in the shelter of a bold rock, we prepare supper and retire early to recuperate strength for the morrow's work. With the first rays of sunlight certain characteristic trees were selected, the camera adjusted, our driver Jesse, with his broad Mexican hat, placed near the trees to exhibit comparative height, and a series of plates exposed. Supplementing these we secured specimens of twigs with their infant cones for pressing in our botanic portfolio, and a quantity of cones with a section of timber exhibiting rings of growth, bark, etc.

The Parry pine—called by the natives piñon—is always a small tree, usually less than thirty-five feet high, with a rounded, close head of slender limbs bearing cones, which at maturity, two years, open widely, discharging the few large, sweet, delicious nuts, then falling to the ground.

Returning to Ensenada we found all its inhabitants gathered on one of the plazas, celebrating the fifth of May victory of the Mexicans over the French, signalized by the execution of Maximilian. Under a canopy were Governor Torres and his staff, representatives of the International Company, etc., while the troops of the capital were out in force; floats, transparencies, and other representations of the varied interests of the place, while from every house and office floated the tricolor—green, white, and red—of the Mexican Republic. Too wearied to participate, we hurried aboard the steamer bound for San Diego.

In concluding this brief sketch the writer has to acknowledge that from first to last on our trip we were greatly disappointed in our observations and experience, and agreeably so. A voyage along the coast years ago, revealed sandy shores and apparently barren hills. Certain travelers had reported derogatively in regard to the territory within, and we remember that a few years ago the project was mooted by our Government to buy the peninsula and use it as a penal colony. But the old Mission Fathers were right in christening it more than one hundred years ago, "Tierra Perfecta"—the perfect land. And only recently, a botanist, the veteran explorer of the southwest, Dr. C. C. Parry, has told us the exact truth and cast the horoscope of the future for Lower California. "Why, don't you see," he exclaimed, with enthusiastic utterance, "that long, narrow peninsula enjoys an insular, mild, equable climate, at just the right latitude, with such diversities of altitude and abundance of water as to amply fit it for what it

is—the loveliest of floral regions—and it will become, when better known, the sanitarium of America, if not of the world."

MRS. J. G. LEMMON.

THIN-BARK PINES.

THIRD PAIR. THIMBLE-CONE, THIN-BARK PINES.

Cone, sub-cylindrical, 1–2½ inches long, strongly declined, falling at maturity or persisting indefinitely. Male flowers, very small; leaves, in pairs; seeds and wings, very small. Trees with exceptionally thin bark, and white, soft wood.

SCRUB PINE.

No. 9. Pinus contorta, Douglas.—Scrub Pine, Twisted Pine.

The little SCRUB PINE detected by Douglas on the west coast of Oregon, but afterward found extending southward as far as Cape Mendocino, is nearer to the horn-coned Gray pine of British America than is the other species of this pine, on account of its usually long persistent cones. But little is known of it, as it is too small for use as lumber, and we are so well supplied with beautiful lawn trees that we are thoughtless of others. However, a fine row of them is in cultivation in the Berkeley arboretum, and they evidently take kindly to the somewhat elevated and sandy soil, and by their close-branched, round-headed form and dense dark-green foliage they prove themselves worthy of trial as wind shelters or ornamental lawn trees, where small, slow-growing trees are desired.

TAMARACK PINE.

No. 10. Pinus Murrayana, Balfour.—Tamarack Pine, Murray Pine.

Until recently this interesting and widely disseminated sub-alpine tree was considered as only a variety of the small, limited preceding species—another case of attaching a house to a veranda, of subordinating a wide-spread tree to one of extremely local range.

However, of late the differences between them have been judged sufficiently numerous and important to raise the Tamarack Pine to the rank of a species, and the puzzling synonomy and incongruity are both cleared away.

The TAMARACK PINE is found in high, wet valleys of the Sierra, usually occupying the ground to the exclusion of all other trees, but often sharing with *P. monticola.*

When young the bark seems to be the favorite food of the so called sap sucker (*Sphyropicus varius*, var. *nuchalis* of Baird), the one with a spooned-billed tongue, with which he scoops out the inner bark for food, making rows of holes in close and regular succession, either longitudinally or transversely, often thereby severely wounding and crippling the tree, or killing it outright. From these and other wounds, these trees are apt to be found exuding abundance of resin, which soon hardens to pitch, giving the species another name of "pitch tree."

Also when young this tree is often attacked by the Western Porcupine, an account of whose ravages is given under the title of "Enemies of Pines."

No. 14—*Pinus Sabiniana*, Dougl. Gray-Leaf Pine, near Auburn, Cal; 180 feet high; altitude, 2,500 feet.

Still another enemy menaces and often kills the young TAMARACK PINES, this one a member of the vegetable kingdom, to wit: the Pine Mistletoe (*Arceuthobium Americanum*), discussed in another place.

Wherever the tree escapes all enemies which take advantage of its thin bark, as stated, and it attains full stature, it is often a very graceful tree, notably in the forests around Webber and Donner lakes of the Sierra, at altitudes of 4,000 to 7,000 feet, usually occupying the ground to the exclusion of all other trees. In this case it often becomes crowded into groves, and hence the trees are there tall and slim, of great service as fencing material, posts, railroad ties, etc. From the frequency of these tall saplings in the high Sierra and their use in making log cabins and temporary structures of various sorts, the tree has been given the name of "Lodgepole Pine." In certain localities, notably wet regions, near Lassen Peak and Shasta, the Tamarack pines crowd into the company of the beautiful MOUNTAIN PINE, the SILVER SPRUCE, and other sub-alpine trees, and vie with them in display of white-barked trunks and light airy foliage.

In localities where the soil is boggy or rocky, limiting the number of trees, they often grow to an immense size and retain their side limbs through life, becoming more rounded or conical in outline, or often they become bent or twisted into forms more picturesque than beautiful.

A tree of such large size, standing on a moraine near Meadow Lake, in Sierra County, was cut to obtain specimens for the Centennial Exhibition. It was 297 years old, 123 feet high, 7 feet in diameter, with a wealth of 360 body limbs on all sides, many sweeping the ground.

As the trees advance in age occasionally one or more of a grove are found dying or already dead without apparent reason, but as the bark falls away from the branchlets they are seen to be twisted tightly on their branches, and later, these also are revealed as tightly twisted and turning downward before falling. Thus it seems that this tree of all others known, often limits its own life by the twisting of its limbs, so preventing the flow of sap. The turns on limbs of trees, noted near Webber Lake, made a complete revolution every inch. The limbs, cracked in spirals from end to end, resemble the screws for a letter press.

BROKEN-CONE PINES.

GROUP 4. BASE-BROKEN CONE, LUMBER PINES.

Cone breaking away at maturity by a transverse fracture within the base, rendering it thereby truncate (*i. e.*, cut away) at the base, and leaving persistent on the limb its undeveloped basal scales. The cones are ovate-conical, sessile or nearly so, spreading or slightly declined, many-scaled—5 spirals inclining in one direction, 8 the other. Seeds about ½ an inch long, wings transparent, beautifully veined with brown. Leaves in threes, and 5-8 inches long, sheaths long, close-wrapped, and persistent. Male flowers large and long. Bark usually very thick and deeply fissured into large sections.

Trees of the largest dimensions, widest distribution, and of the utmost value for lumber, fuel, etc.

One pair of species, each species with three varieties.

YELLOW PINE.

No. 11. Pinus ponderosa, Douglas.—Yellow Pine, Heavy Pine.

BLACK PINE.

No. 12. Pinus Jeffreyi, Murray.—Black Pine, Sap-wood Pine.

THEIR FORESTAL IMPORTANCE.

Of the twenty-three species of pine found on the Pacific Division of the United States, eighteen species are of the class called Pitch Pines, or Hard Pines, to distinguish them from the White or Soft Pines, five species of which inhabit the same region.

Chief of the Pitch Pines in many respects—size, quantity, quality, etc.—is the magnificent YELLOW PINE—*Pinus ponderosa*—and its nearest relative, the BLACK PINE—*P. Jeffreyi*—forming the greater part of the noble forests of the Sierra and Rocky Mountains, and consequently they are of the first importance as comprising a great part of the natural wealth of the region. Only their majestic companion in the Sierra, the GREAT SUGAR PINE—*P. Lambertiana*—and the world famous Coast REDWOOD—*Sequoia sempervirens*—and the Oregon RED SPRUCE—*Pseudo-tsuga Douglasii*—can at all compare with these two species in economical or forestal importance.

The Pacific YELLOW PINE and the BLACK PINE are so variable in appearance, qualities, uses, etc., and, moreover, until recently have been so little studied, that an investigation by Special Experts, as lately instituted by the State Board of Forestry, is at once most desirable for the advancement of scientific information, and also most opportune, economically considered, in view of the fact that at the present time, more than during any other period since the discovery of gold in California, thousands of persons are looking to the far West, studying its attractions, resources, etc., while capital is seeking new methods of utilizing its immense natural wealth.

THE DISCOVERERS.

The history of the discovery of these trees, along with others of the great western forests, fills volumes of early exploration. Briefly, David Douglas, a Scotch botanist, exploring the northwest coast of America, under the auspices of the Horticultural Society of London, during his first trip, in 1825, while exploring extensively in Oregon and Washington, was the fortunate first collector of several important species of trees, including this Pacific YELLOW PINE, which, from its heaviness, he named *P. ponderosa*. As discovery advanced into the interior and southward, other forms were met with by other explorers, and as a consequence nearly a dozen different names have been given to forms of this polymorphous species.

It is only recently that the other species under consideration, the BLACK PINE, which had all along been called a variety of the ponderosa, was allowed to take rank as a distinct species—*P. Jeffreyi*. This pine was first collected in 1852-3 by John Jeffrey, a Scotch gardener, and was named, as above, in his honor; by Professor Murray.

Descriptions of *ponderosa*, more or less technical and elaborate, have appeared in about fifty standard periodicals, with thirty-three descriptions of it under other names, as *P. Benthamiana*, *P. resinosa*, etc.

The BLACK PINE has been described in the same periodicals about a score of times, and nearly as many times under other names, as *P. deflexa*, and varieties of *ponderosa*.*

SEEKING INFORMATION.

For the prosecution of the investigation at present undertaken, in addition to personal inspection of the forests during twenty years past, reliance has been placed upon the dissemination of a "circular," presenting a brief description of the two species, followed by a double series of questions.

Though not eliciting as many and as full responses as hoped, yet acknowledgment is due for several valuable communications.

William B. Tiffany, of Truckee, California, returned elaborate replies, covering economical and biographical information concerning a most interesting and extensive lumber region of the West. Mr. C. F. Sonne, of the same place, added important statistics from his ample resources as bookkeeper of the Truckee Lumber Company. Hon. H. K. Turner, of Sierra Valley, and J. D. Keefer, of Nord, both of Northern California, gave nearly full reports from their regions respectively. J. W. Snodgrass, of La Grand, Union County, Oregon, reported for the extensive forests of his State; and L. C. Seaton, of Teonoway, Kittitass County, Washington, gave a good report from that Territory. (See Special Investigation.)

DISTRIBUTION AND HABITAT.

With the single exception of the DOUGLAS SPRUCE (at the north improperly called "Oregon pine"), which has about the same range, the Pacific YELLOW PINE has much the widest distribution of any other timber tree of the West.

According to Sargent, a very large portion of the Pacific region is given as the home of this ponderous pine, with its headquarters in the Sierra Nevada. His map gives the distribution in a general way over all the ranges of the Sierra and the coast mountains, to their termini in Southern California, and including the great valley of California between them; thence, extending northward to British Columbia. At the north the cross ranges of Oregon and Washington carry the species over to the Rocky and Wasatch Ranges, where it spreads thinly out over a broad belt extending southward to and beyond the Mexican boundary.

The outlying Black Hills of Dakota are correctly shown as also inhabited sparsely by this species.

The great interior basin of Utah and Nevada, between the Rockies and Sierra Nevada, however, is devoid of this species, and so are several other quite large areas, notably the valley of California—erroneously represented on Sargent's map as occupied by this species.

The vast region positively known to comprise the home of the YELLOW PINE includes all of the Sierra Nevada except barren portions of its southern termination, and a much larger middle section of the Rocky Mountains, with the cross ranges connecting at the north, as mentioned, and a scattering growth on the coast ranges.

The other species under consideration—*P. Jeffreyi*—is limited entirely to the Sierra Nevada and its prolongation southward, at elevations of four thousand to ten thousand feet.

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*Sargent's Forest Trees U. S. 192–194. Bot. Cal., Vol. II, 123–554–557.

YELLOW PINE rarely comes down upon the mountain slopes to the edges of the great valleys and basins, but is there supplemented by other species; nor does it ascend the slopes to the timber limit, giving way there also to other species.

The elevation of the lower limit differs with different ranges and with different latitudes on the same ranges, from a few hundred feet to four thousand feet. The upper limit in the mountains of Arizona and New Mexico is at about eleven thousand feet. In Oregon and Washington the YELLOW PINE is supplanted by other species of pine and by fir and spruce trees at elevations of six thousand to eight thousand feet.

THE YELLOW PINE rarely occupies the ground to the exclusion of other trees, but is most frequently accompanied by other species of its own interesting family and by allied evergreens, of which there are many species of spruces, firs, hemlocks, cypress, larch, junipers, etc., in the region mentioned, and, in a few localities, oaks, poplars, laurel, and other broadleaved trees are co-inhabitants with YELLOW PINE.

PHASES OF DEVELOPMENT.

The Broken-coned pines of the Pacific Slope, if considered as distinct species (*ponderosa* and *Jeffreyi*), which is very much doubted by some observers, present a great many intermediate connecting forms and special characters both of economic and biological importance.

The economical features will be discussed farther on in connection with a "Circular of Inquiry."

Before reaching that, it is pertinent to discuss briefly the life-history, appearance, and the like, of this remarkable and most valuable group of pines.

The first thought that must enter the mind of a reflective observer when he finds himself in a Sierra forest is, that a half dozen or more kinds of pines are about him, and such, indeed, is the lumberman's view of the subject. He sees yellow-barked trees with large longitudinal plates, which, when cleft by his ax, crumble to hundreds of buttons, revealing but a few layers of sap-wood. The next tree met with may have darker, harder bark and more layers of sap-wood. A third tree will intensify these characters, and so on until perhaps not five rods away is a black-barked, low-limbed tree that he might cut almost to the center before reaching the heart-wood. And the cones of these several forms will vary as greatly; generally the smallest cone produced by the lightest-barked tree.

Other species of pines, notably the Long-coned white pines, exhibit great variation, as described under the proper heads, and all dependent upon differences of locality; but here in a given small section of a dense forest it may be, trees of most diverse qualities and characters, yet botanically considered of the same species, are met with in confusing abundance.

Like all the cones of this group—the Base-broken Cones—when matured, separate from the tree by an irregular transverse fracture within the base of the cone, exposing the conical lower end of the receptacle (central column of the cone), and leaving persistent on the branchlet the small, undeveloped, basal scales surrounding a conical pit corresponding to the removed receptacle. In the middle Sierra the cones mature and begin to fall about the middle of September, continuing for a month or more.

The yearling cones are elliptical, one half to one inch long, the pointed scales appressed and directed toward the apex.

The male flowers, discharging their pollen in June, are the largest of any in the family, often three to four inches, usually half that length, always

flexuous and numerous. The yellow pollen grains, discharged in abundance, often fill the air with clouds of dust.

YELLOW PINE.

No. 11. Pinus ponderosa, Douglas.—Yellow Pine, Heavy Pine.

The form that is always called the YELLOW PINE is, when fully developed, a tree of the first class, 6–10, even 15–20 feet in diameter, 150–200, or rarely, 250–300 feet high. It may always be detected by the color of the bark, which is usually whitish-yellow (not brown, reddish, or black), generally very thick, 4–6 inches, deeply fissured irregularly into mostly large, longitudinal plates, which are soft, flaky, crumbling before the ax into small, sinuous lozenges or buttons, and releasing a quantity of yellow or orange powder between them. The sap-wood, even of small trees, is very thin, the annual layers of this tree being soon converted into the condition of yellowness and dryness called heart-wood, at a remarkably early age, and so continuing through the life of the tree; trees of the largest dimensions often having but one or two inches of sap-carrying, living wood, leaving the great shaft within perhaps clear of sap or resin for several feet.

The leaves of the typical PONDEROSA, which we are considering, are comparatively short, 6–8 inches, dark-green, never white-glaucous, and, in old trees only, two or three years' growth remain on the tree at a time on the twigs, hence these present a tufted, brush-like appearance.

The cones are always small, 2–4 inches long, of a rich brown color outside, when mature, dark mahogany within; the scales with small, erect, or incurved prickles. The phylotaxy, or spiral arrangement of the scales, presents two principal sets inclined in opposite directions; 5 in one direction, 8 the other; but these spirals, most unexpectedly, are not constant. The spirals of either number may turn to the right or the left on different trees, or even in cones of the same tree.

Such described trees are always called YELLOW PINE. The other forms included by botanists with this, receive other names from lumbermen. The YELLOW PINE, as limited by the foregoing description, is not abundant in the forests, does not comprise the largest number of the trees of any region; hence, is seldom kept separate from the others in manufacturing. This leads to the uncertainty, almost the impossibility, of obtaining statistics of characters and values of the real, true, YELLOW PINE lumber.

VARIETIES OF YELLOW PINE.

The most marked varieties of Yellow Pine are three in number, forming the outlying extensions of the YELLOW PINE forests, whose general headquarters are in the Sierra.

First. Variety (*a*) *Benthamiana*, Hartweg—Foothills Yellow Pine: This pine was so named by Hartweg, who first met with it in the Santa Cruz Mountains, in 1846, and afterwards on the western flanks of the Sierra, near Auburn. This is usually a medium sized tree, 100–150 feet high, and 2–5 in diameter, with dark, thick, deeply fissured bark, thin sap-wood, and fair lumber-making heart-wood. Young trees are now seen in the region mentioned 10–15 years old, of beautiful, spire-like form, and dark, apple-green foliage, in agreeable contrast to the ashen hue of the GRAY LEAF PINE usually accompanying it, or the still darker shade of the young WHITE FIR and DOUGLAS SPRUCE of the region. The yearling cones are oblong, nearly an inch long on peduncles half as long, drab-gray, with short, appressed,

pointed scales. Mature cones the second season, light green before opening, long and narrow, 3–4 inches long, and 1–1½ as thick, becoming, when opened, long, ovate, truncate, and leather-brown. The seeds are pale, with large—1-inch—transparent wings, slightly veined with brown pigment.

Second Variety (*b*) *brachyptera*, Engel.—Southern Yellow Pine: This pine, so named by Dr. Engelmann, is the form of PONDEROSA that inhabits Arizona, New Mexico, and southward into Mexico. It is a small tree, 80–100 feet high, rarely more. Leaves 3–6 inches long, often in pairs. Cones smaller, 2–3 inches long. Seeds small, wings ½–1 inch long, and transparent. A peculiarity of this form is the long plume-like appearance of the branches, caused by the longer persistence of the leaves.

This pine was so named by Dr. Engelmann, from a mistaken impression that the seed-wings were very short. A tree of medium size, 100–200 feet high, and 2–6 in diameter, found abundantly on the San Francisco Plateau, in Northern Arizona, and less abundantly on other mountains of Arizona and New Mexico, extending into the northern States of Mexico, where Dr. Wislizenus first discovered it in 1848. The great plateau of Northern Arizona and New Mexico mentioned is composed of volcanic scoria, the overflow of the great volcano of Agassiz, standing on its northern end, and is covered throughout its extent, one hundred and fifty by seventy miles, with a noble forest of this pine. Minor forests inhabit the summits of the other ranges of the region southward.

Lumber factories have been recently established in this forest, and large quantities of fair lumber is supplied to the usually timberless region of the vicinity. Flagstaff, near the base of Mount Agassiz, is the headquarters of this enterprise.

NOTE.—In later publications Dr. Engelmann admitted the inappropriateness of the name *brachyptera*—meaning short-winged—for the seed-wing of the southern form is not noticeably shorter than those of the typical form; however, under the rules of botanical nomenclature, we are not at liberty to change a name on account of its inappropriateness only. It often happens that a name eminently descriptive when first applied, becomes in the progress of research quite inappropriate, often totally misleading, so that botanists have come to regard descriptive names—so pleasing and satisfactory to the common reader—as not to be insisted upon in giving names, and therefore a jumble of letters forming a word that is short and easily pronounced, but of no meaning whatever, is a welcome appellation, because, while it clearly designates by its use, it can never mislead.

Third Variety (*c*), *scopulorum*, Engelmann—Rocky Mountain Yellow Pine: A small spire-formed tree in the Rocky Mountains, and extending as far eastward as the Black Hills of Dakota. Its bark is thinner and harder than the typical form. A peculiarity of this variety is that it often bears its leaves in twos instead of in threes.

INDIVIDUAL YELLOW PINES.

A tree near Shasta displayed over three hundred annual layers, was seven feet eleven inches in diameter, over two hundred feet long, with few short body limbs; would yield four thousand feet of lumber in five logs of sixteen feet each. (A type of the prevailing form of yellow pine of that region.)

A yellow pine in Sierra Valley was three hundred and twenty years old, two hundred and fifty feet high, six feet in diameter, with whitish-yellow bark five inches thick, in large, longitudinal plates, and crumbling before the ax in scores of small, rounded buttons, one to two inches across. Specimens of this tree—wood, bark, boughs, fruit, etc.—were sent to the Centennial Exhibition, as representative of the typical yellow pine of the Sierra.

A yellow pine near Loyalton was standing, very strangely, in a copse of willow near a running stream; a large, vigorous tree, one hundred and fifty feet high, six in diameter, with typical whitish-yellow bark. Such locations for the yellow pine are of rare occurrence.

A tree of the variety *Benthamiana*, near Auburn, was one hundred and fifty feet high, four feet in diameter, had dark-brown bark, reddish within, and deeply fissured; cones, four to five and one half inches long. A fair type of this variety peculiar for its dark, not yellowish, bark.

Yellow pines are met with in the Southern Sierra of immense size and noble appearance. I have paced across the shadows of some that were twelve to fourteen feet in diameter.

BLACK PINE.

No. 12. Pinus Jeffreyi, Murray.—Black Pine, Sap-wood Pine.

The BLACK OR JEFFREY PINE, as at present classified, includes a number of forms perhaps arbitrarily separated from the other forms of base-broken-coned pines, and distinguished chiefly by larger cones, by usually smaller-sized trees, more symmetrical contour, with longer-retained, body limbs (hence, less desirable, clear-lumber trees), darker bark, thinner and finer fissured. Sap-wood tardy in changing to heart-wood, hence usually becoming very thick, often comprising the most of the tree trunk; heart-wood consequently meagre, often very little even in large trees; usually resinous and heavy. The leaves are generally longer and stronger than YELLOW PINES when young, and in one form glaucous, as well as the young branchlets, the latter, when broken, giving off the fragrance of oil of orange.

VARIETIES OF JEFFREY PINE.

The forms of broken-coned pines included at present under *P. Jeffreyi*, or BLACK PINE, are readily distinguished by lumbermen as black, red, sap, swamp, bull, hard pine, and the like, according to qualities.

Botanists are able to detect at least four marked forms.

First form: The original *P. Jeffreyi*, of Jeffrey's discovery, in the high valleys 20–50 miles to the north and west of Mount Shasta. This tree is always found at high elevations, at least 6,000 to 9,000 feet, on such formations of the mountain ranges as were first laid bare after the glacial epoch; therefore, the oldest of the broken-coned pines, and perhaps the common parent of all the other forms, including those of the YELLOW PINE described.

This, the typical *Jeffreyi* form, is often a large tree 4–6 feet in diameter, but not proportionately lofty, being rarely over 200 feet high. It usually presents a large, broad, dome-shaped crown in contour, with few long, usually-drooping limbs; bark dark-brown, thick, with large checks; sap-wood thick; the heart-wood not determined; yearling cones, purple, large for the genus, elliptical, $1\frac{1}{2}$ inches long, on peduncles $\frac{1}{2}$ inch long; mature cones very large (the largest of the group), 6–8, rarely 9–12 inches long, elliptical, truncate after falling, purple until maturity, then expanding to long-oval with many scales nearly erect, more strongly spreading than other members of the group; seeds about $\frac{1}{4}$ of an inch long, pale, with brown veins above; wings narrower than other forms, an inch to an inch and a quarter long, $\frac{1}{4}$ of an inch wide, translucent, slightly veined with brown.

Trees of this form, which must be regarded as the true *P. Jeffreyi*, are sparsely met with in many other localities of the Sierra, always at high elevations, usually on spurs or outcroppings of granite, in a westerly or southerly direction, though often in a valley that was early drained of its glacier mud.

They are at once detected by their strange habitat, which is above the common forms of the YELLOW PINE, perhaps in the contiguous forests below, and by the long, drooping limbs and the large, many-scaled longer cones than others of the group. Interesting trees of this description are met with on the flanks of Shasta and Lassen, the numerous peaks of the Northern Sierra, and especially near Webber Lake and Lake Tahoe.

Second form may be designated Variety (*a*) *nigricans*—Black-bark pine. This form comprises representatives of the dark-barked, long-coned section (*Jeffreyi*) of the broken-coned pines that occupy lower altitudes in the same regions as the other forms, and usually mingled with true *ponderosa.*

Trees of medium size, 120–150 feet high, flourish near stream-banks more than other forms, long retaining their body-limbs, and hence forming symmetrical, spire-shaped outlines. Bark black, hard, thick, rather coarsely checked. Sap-wood very thick; heart-wood consequently meager, usually very resinous.

The Third form may be designated as Variety (*b*) *deflexa*, Torrey—Red-bark Pine. This form constitutes the principal timber tree of the higher Truckee region, and similar regions north and south of that noted lumber station.

The trees are of the largest size for this section of the broken-cone group, comparatively tall, and free from body-limbs. Bark thick, reddish-brown, hard, coarsely checked; sap-wood not thick; heart-wood of the most desirable quality. Yearling cones apple-green, large, narrowly ovate, ½–1 inch long, becoming at maturity widely open and 3–5 inches thick at the base, which is truncated. Yearling cones purple, about one inch long, on short peduncles. Mature cones, long-ovate, 4–8 inches long, when fallen, truncate at base and broadly oval by the expansion of the scales. Seeds large, with large, broad wings, 1–1½ inches long by one half as broad; translucent with few brown veins. Leaves longer and stronger than the neighboring YELLOW PINE, and white glaucous, especially when young. The young shoots are also glaucous, and when broken they exhale a fragrance similar to the oil of orange.

(This is doubtless the form of pine collected by Dr. Parry in 1849, on the "Summit of the Cordilleries of California," and described as "a handsome tree, with an even, columnar trunk, leaves long, 7–8 inches, slender, sheaths short, cone ovate-acute [the figure is of a cone but ¼ grown], apophysis of the cone-scale compressed-pyramidal, deflexed, umbo broad, hooked, recurved, wing twice as long as the seed," named and published by Torrey as *P. deflexa* in Bot. Mex. Bound. Survey in 1858 [but the cone figured was one but ¼ grown]. As Jeffrey's discovery, though later made, was earlier published, Balfour's name of *Jeffreyi* for the species is accepted by botanists, and Torrey's disused name of *deflexa* may now be taken up again for this variety.)

Fourth form may be designated, from its locality, Variety (*c*) *Peninsularis*—Peninsula Pine. It is found only on the mountains of the peninsula of Lower California, east of Todos Santos Bay, at an elevation of about 4,000 feet, and forming an extensive forest upon a substratum of crumbling,

No. 14.—*Pinus Sabiniana*, Dougl.—Gray-Leaf Pine, Tehachapi Mts., Southern California. Alt. 1,800 feet.

white-sand rocks. Trees of medium size, 150–200 feet high, with full, spire-form, or more rounded outlines. Bark grayish or drab, thick, hard, deeply-fissured. Sap-wood not thick, heart-wood undetermined. This noble forest, clothing the central mountains of the peninsula, is almost untouched by the ax of white man as yet, and presents a beautiful appearance with its densely placed trees, interspersed with intervales and parks of green meadows or sweet-water lakes. This PENINSULA PINE, when standing alone, presents a dome-shaped form, with drooping limbs. Yearling cones very large, 1–1½ inches long, elliptical and purple. Mature cones abundant, many years' crops lying under the trees, all large, broadly-ovate, 6–8 inches long, truncate at base, mahogany colored, with prickles strongly reflexed.

INDIVIDUAL JEFFREY TREES.

A tree of the true Jeffrey type, with brown bark and long, drooping limbs, near Lake Tahoe. was 200 feet high, 6 feet in diameter, with thick, brown bark, deeply and coarsely fissured, extending to the lower part of the upper limbs, the rest whitish and beautifully braided with black. Cones elliptical, over 9 inches long.

Another, near Quincy, was 5 feet in diameter, 175 feet long, dark, almost black bark, deeply fissured on the trunk, braided on the upper portions. Contained 6,000 feet of lumber, worth $70. A type of many in the vicinity.

Another, in Eddy Valley, near Shasta, was over 200 feet high, 6 in diameter, 240 years old, with dark bark, not braided above. Cones elliptical 9-12 inches long. A type of the original Jeffrey Pine abundant in the vicinity.

A tree of the var. *deflexa*, Torr., the RED-BARK PINE, near Greenville, was 143 feet high, 3½ thick, and yielded 5 clear-cut logs 16 feet long, worth $50. The earliest formed (inner) foot of layers counted 75, the others 105, showing the early rapidity of growth.

Another, near Truckee, was 170 feet long, 4 thick, yielded 6 logs 16 feet long, worth $60. First foot of rings 78, the rest 165 rings.

Another, near Webber Lake, was 150 feet high, 5 in diameter, yielding 5 logs 16 feet long, worth $50.

Another, near Truckee, was 200 feet high, 7 feet in diameter, over 400 years old, and yielded 6 logs, 20 feet long, worth $80.

This was a type of the large forest of pines of that noted vicinity—now nearly all removed for lumber.

A tree of the variety *nigricans*, the BLACK-BARK PINE, near Beckworth, was 175 feet long, 4½ in diameter, about a foot of the center had become heart-wood that abounded in resin. A type of many of the trees of the region.

Another, near Sierra Valley, was 5 feet in diameter, 175 feet long, 240 years old, with thick black bark, deeply fissured below, nearly smooth above. Yielded 6,000 feet of lumber, worth $70. A type of many trees in moist situations.

A singular tree, in an open situation near Sardine Valley, was 200 feet high, 5 in diameter, with very thin black bark only ¾ inch thick. Cones very large, with prickles strongly deflexed. A rare exception to the usual condition in the thinness of the bark.

Another tree, near Sisson, was 220 feet high, 340 years old, 6 feet in diameter, with dark, deeply cleft bark, and numerous body limbs.

HEAVY-CONED PINES.

SECTION B. MOSTLY LATERAL, PERSISTENT-CONED, COARSE-GRAINED PINES.

Cone, lateral, *i. e.*, arising along the bearing shoots at some distance from the apex; verticillate or clustered and declined, mostly not falling at maturity, but persisting, and either becoming inclosed by the later layers of wood, or the peduncle is stretched and at length broken by the enlargement of the tree, and the cone is carried outward confined in the bark.

Seven species on the Pacific Slope, six in California, mostly near the coast; in two unequal groups, a pair and a trio, with a solitary species between.

GROUP 5. HEAVY, SPINE-CONE, LONG-LIMBED PINES.

Cone of the heaviest, largest, and hardest description, on long, stout, spreading peduncles, opening at maturity and scattering the seeds, but usually remaining persistent until forced off by the enlargement of the tree, then leaving often a few basal scales persistent. Scales, very large, broad, and thick, terminating in long, stout, incurved hooks; seeds, large, black, and thick-shelled, edible; leaves, in threes, very long. Male flowers an inch long.

Picturesque trees of the interior foothill regions, remarkable for their usually divided trunk or very long limbs, and for their very heavy, spine-bearing cones.

The two heavy-coned pines form a very distinct type of development, massiveness and protection being the leading ideas. These trees are never slim and feeble as those that are crowded into groves, but are always scattered more or less, and, therefore, have room to broaden out or branch freely. They inhabit the hot, scorched hills and sun-filled valleys, contending there for space with dwarfed oaks, manzanitas, and chaparral.

It would be interesting to discover what end is subserved by the exceeding size and firmness of their fruit with their formidable armament of spines. That it is a special adaptation of conditions to environment we may be sure; that all the special developments they display are modifications of defensive or offensive weapons used in the warfare of life is granted. Now what are the obstacles to the enemies of this line of development? The regions they inhabit are peculiarly exposed to the keenest action of the sun's heat, without mitigation by cool ocean atmosphere, or protection by sheltering forests. No doubt a thick, strong investment of carpellary scales defends the ovules during growth better than would a light covering of thin, soft ones.

Another consideration: The regions these pines occupy are usually infested beyond precedent the world over with colonies of ground squirrels that—as may be seen at any time by examining the cones lying about their quarters—find it very difficult to gnaw into the matured, hard-scaled and forbidingly armed cones of these pines, whose large seeds would perhaps otherwise furnish abundant squirrel food, and these species would, therefore, suffer abridgment or even total extinction.

And, too, it may be that the thick-scaled fruit of these trees is better fitted to resist the attacks of depredating insects that infest and, in noted forest regions, nearly render abortive the seed crops of certain soft-scaled pines and spruces.

BIG-CONE PINE.

No. 13. Pinus Coulteri, Don.—Big-Cone Pine, Coulter's Pine.

Dr. Thos. Coulter, another indefatigable Englishman, had the good fortune to discover the BIG-CONE PINE in 1831, together with *P. muricata* and several other interesting trees, while on his way from Mexico to Alta California. At Monterey he fell in with Douglas, who thus describes him: "Since I began this letter Dr. Coulter, from the Central States of the Republic of Mexico, has arrived here, with the intention of taking all the plants he can find to DeCandolle at Geneva. He is a man eminently calculated to work, full of zeal, very amiable, and I hope may do much good to science. As a salmon fisher," he adds, showing that this industry was, as now, prosecuted at that place, "he is superior to Walter Campbell, the Izaak Walton of Scotland, and he is a beautiful shot with a rifle, nearly as successful as myself. I do assure you," he continues, "from the bottom of my heart it is a *terrible* pleasure to meet a really good man, one with whom I can talk on plants."

In order to understand the importance of the discoveries of Dr. Coulter—the journeyings, the sharp-sightedness necessary, and the indomitable perseverance of the man—it will be necessary to sketch briefly the south coast ranges of mountains, which are of much forestal importance as the habitat of several quite local species. They all begin like rays or spokes on one side of a wheel, commencing at points or promontories on the coast, and extending inland. They converge at a point or plexus of high peaks at the south end of the San Joaquin Valley and opposite to the Tehachapi or southern end of the great Sierra. The longest ray is that of the Santa Cruz Mountains, beginning with Point Lobos, on the peninsula of San Francisco. Below Santa Clara Valley it is joined by the Mount Diablo Range, and continues down, forty to sixty miles from the coast, to the place of meeting. This is a low range, and being flanked on the coast side by another that has first access to the ocean atmosphere, it suffers the loss of moisture, and its forest, consequently, displays the deprivation by developing but few trees.

The next range, the Santa Lucia, begins with Point Pinos, with its interesting and very local species, the MONTEREY PINE, and extending southeastward it traverses Monterey and San Luis Obispo Counties, well watered the while on its way to the junction mentioned. This is a much diversified, steep-sided mass of mountains that consequently must furnish rare forms of development, though this must have been unknown to our pioneer explorer.

The third range, the San Rafael, with its promontory at Point Sal, on the northern boundary of Santa Barbara County, extends nearly eastward to the junction in a direction unfavorable to the catchment of moisture; hence found to be devoid of remarkable flora.

The fourth range, or wheel spoke, the Santa Inez Mountains, begins with the noted Point Concepcion and extends due eastward to the plexus of peaks.

Immediately southward of this range the ocean has approached parallel and washes the foothills for a distance of 80 to 100 miles, the northern currents of air caught by the light range described, are utilized by the production of a peculiar and abundant forest also.

Missing the few little dwarfed and depressed trees on the limited bluff of the San Diego coast (TORREY PINE), Dr. Coulter passed along scanning and exploring every reasonable locality for trees, making some trips of

such great difficulty as to be but seldom repeated since, and collecting nearly all the rare forms of the region.

Noticing the trend and the elevation of the ranges one after another, he fixes his attention at last upon the Santa Lucia, and penetrating to its highest elevation, which he learned that the Mexican inhabitants called the "Crusta," a few miles southeastward of the present town of San Luis Obispo, he finds thereon, crowding its white sand peaks, a species of pine, the like of which was never seen before. Tall, large branching trees were loaded with monstrous and heavy cones of several pounds weight, most of them still attached to the trees, all armed with huge, hooked spines, while the large leaves were half as long as his arm.

No wonder the intelligent explorer became greatly excited over his discovery, and when, a short time after on his way northward, he added the little egg-shaped PRICKLE-CONE PINE to his discoveries, we can willingly excuse him for holding his head well up when he met the veteran explorer Douglas at Monterey; and in his zeal he tried to make several species out of the materials in hand.

Strangely enough this same sturdy climber, penetrating the Santa Lucia at a third point, discovered and secured good specimens of that most beautiful and curious of fir trees, *Abies bracteata.*

In May, of 1887, Mrs. Lemmon and I climbed to the original locality of Dr. Coulter's discovery of the BIG-CONE PINE, to wit, the "Crusta" of the Santa Lucia Mountains.

The trees can be plainly seen from the town of San Luis Obispo, just peeping over the highest peaks. The day was hot, the way is steep, and the sand moved under foot, but thinking of Coulter's climb thirty-six years before, and his triumphant success, gave us courage to struggle with the hardships and to succeed, as he did.

And the BIG-CONE trees, what more interesting sight in California—in all the world? Large, tall, long-armed trees holding out seeming baskets of fruit; other baskets fresh, and empty or discolored with age, strewn beneath, each basket, when examined, being an oblong cylindrical mass of hooks a foot or a foot and a half long and one half as thick, so heavy that you take both hands to raise them from the ground, the fresh ones still discharging their dark, large-winged seeds.

Upon examination this group of trees comprise a forest of some considerable extent, being several miles long, irregularly distributed over the flanks of the peaks. The largest of the trees are one hundred and twenty to one hundred and fifty feet high, three to five in diameter, and with dark, deeply fissured bark. The leaves in this locality are of the largest and longest description, eight to fourteen inches long—the largest of any in the Pine family.

The general appearance of the trees reminds of the typical *Jeffreyi*, the flowers being very similar, the seeds and their wings but little larger, while other characters of leaf and cone recall the TORREY PINE.

The male flowers growing in tufts near the ends of branchlets are of a light creamy color, the spikes ovate-oblong (one inch), and half as thick. But it is in the cones that this species excels all others. Generally singly, but often in pairs, or rarely in threes, they hang in an inclined position from the limbs, their shining, spine-covered proportions half protruding beyond the long leaves, often a foot or so.

Like the other pines of its section—GRAY-LEAF, MONTEREY, KNOB-CONE, and PRICKLE-CONE—they are mostly long-persistent, though quite variable in this respect. Sometimes the remains of cones are seen deeply imbedded

in the bark of large trees, the larger part of the cone having broken away and fallen.

During the latter part of June, of the present season (1888), we proceeded to a noted range of mountains for the study of forestry, that of the San Bernardino, and pitched our tent in the cañon of Mill Creek, about eight miles above its mouth.

Here, at an altitude of about 1,700 feet, robust, symmetrical trees—BIG-CONE—were met with most unexpectedly, when we recalled the high mountain top of the other region, these being along the water-courses, while above them appears a species of spruce which, elsewhere, is a lover of damp, shady situations, namely, a variety (?) of the DOUGLAS SPRUCE.

Further up the cañon and up the slopes of the mountain, generally to an altitude of 6,000 or 7,000 feet, were other and very large trees of this BIG-CONE, interspersed with others of the family, notably the southern form of the Jeffrey pine, which here it closely resembles in the characters of its long, spreading limbs, but always to be distinguished by its darker, denser foliage, added to its ponderous fruit characters.

Evidently the timber of this pine was once used for lumber, for here, in the upper portion of Mill Creek Cañon, are the ruins of a lumber factory, and the clean stumpage, including every accessible tree in the vicinity, shows that no discrimination was used; but the mill was deserted over twenty years ago, and no one could be found who could give any opinion as to the character of the timber the Big-Cone Pine produces. It is probable, however, that the trees being generally on higher locations, with harder bark and closer grained sap-wood, it makes better lumber than the Gray-Leaf Pine.

GRAY-LEAF PINE.

No. 14. Pinus Sabiniana, Doug.—Gray-Leaf Pine, Sabine's Pine.

It was when David Douglas made his second visit to the northwest coast of America, in 1830, that he explored the region around Monterey Bay, and discovered first, of course, *P. insignis* right at the ship's wharf, and subsequently the Gray-Leaf Pine farther interior, making the announcement to his London friends:

"I have added a new and most interesting species to the genus of *Pinus*, viz., *P. Sabiniana*, and which I discovered in 1826." [This is an error; the pine of that allusion was *P. Lambertiana*, far to the northward.] "When compared with many of the genus inhabiting the western part of this continent, its size is inconsiderable, not above 110–140 feet high and 3–5 in diameter. It grows in aqueous deposits [?] on the western flanks of the Cordilleries of New Albion" [once the name of California], "at the elevation of about 1,600 feet above the sea and below the line of perpetual snow. I sent a detailed account of this most beautiful tree to be published in the transactions of the Horticultural Society."

It was first published, however, in the great illustrated work of Lambert in 1842, in the following words: "Native of the Cordilleries of New Albion. Discovered by our indefatigable friend, Mr. Douglas, who was the first to open to us the vegetable treasures of the little-known regions of the Western Hemisphere."

Douglas named it in honor of his early friend and patron, Joseph Sabine, "the zealous Secretary of the Horticultural Society." In this first description is noticed the curious fact of the great change of appearance the cone undergoes, "during the first year rounded and bright green, when perfected the following November, elongated and brown." But throughout, no men-

tion is made of the divided or long-branching habit of the tree, or of its sparse foliage and its light-greenish color.

The northern forms of this species are usually marked by thinner foliage and less strongly-hooked cones than southern ones. In the Sierra foothills, near Auburn, the leaves are very few and light colored, while the plant is often attacked at every stage of its growth by parasites, the most deadly of which is the pine-girdler, a fungus treated of elsewhere under "Enemies of the Pine."

In southern sections, notably in the upper (southern) end of Salinas Valley, this pine is much less attacked by parasites, and the trees usually display heavier, but still light and airy foliage, produced principally at the ends of the upright branchlets. On the Tehachapi Mountains the trees are quite dark green, with abundant foliage, large cones with strong hooks, etc., in these respects closely approaching "Big-Cone."

If this were the only difference it would be difficult to distinguish the two, but the larger seeds and short wings always distinguish the Gray-Leaf from Big-Cone, with its half-size seeds and very large wings.

These Tehachapi trees also exhibit very long peduncles, 4–6 inches long, and make their downward turn near the end, during the first season.

The Gray-Leaf Pine, on account of its divided or freely branching habit, often resembles a willow more than a pine, while its light, almost pea-green foliage at a distance on hill-sides reminds one of clouds of smoke.

When the Europeans first began the occupation of California, they found the aborigines of the coast region, called by them "Diggers," subsisting for a part of the year upon the seeds of this pine, and so the tree was nicknamed "Digger Pine." But since a few individuals only now survive, and these prefer the white man's flour to climbing trees for pine cones, the uncouth name for this interesting tree should be discontinued for one which must always be characteristic, as it is derived from its most striking character—to wit: its singular, long, grayish leaves.

So fast does the Gray-Leaf Pine grow, and so coarse are its grains, that lumber made from it is much given to warping if exposed to heat, or decay if it touches the earth. A lumber factory in the Huerhuero Valley, near Paso de Robles, annually makes a quantity of poor lumber for indoor, sheltered work, but as a rule this species, wherever found, is not used for either lumber or fuel, while its usually thin foliage prevents it being very desirable for shade or shelter.

INTERMEDIATE, SOLITARY SPECIES.

A peculiar lone species (perhaps a vestige of a former forest), in classification between the pairs of this group; the cones being often both subterminal and lateral, also sub-persistent, etc.

TORREY PINE.

No. 15. Pinus Torreyana, Parry—Torrey Pine, Lone Pine.

A few small trees buffeted, often prostrated, by ocean winds on the bluffs at Del Mar, San Diego County; and a smaller number (about 100) detected the present season (1888) by T. S. Brandegee, on the east (the shore) end of Santa Rosa Island, 120 miles north of the other locality.

The Torrey Pine, as shown by preceding characters, is a curious species somewhat anomalous in its natural history, and exciting great interest on account of its small representation, only a few trees existent, the singu-

larity of its locality, mostly in a limited ocean bluff region, 50 miles from any other trees of the Pine family; and from the vigorous appearance of the few individuals that hold tenaciously to the soft sand rock, and produce large, sound cones in larger quantity than relatively larger trees do in apparently more favorable localities.

A doubt has been lodged against the priority of Parry's name for this pine in favor of Loiseleur's name of *P. Californica*, given in 1787 to specimens of a pine collected by Colladon, the gardener of the expedition of La Perouse, near Monte Del Rey. "The cone," the chronicler relates, "was of the form of *P. pinaster*, but one third larger in all its parts. Leaves in twos or threes; seeds of the size of *P. cembra*." [Which would be very large; indeed, the only character given that at all accords with our *P. Torreyana*.]

"Seeds were taken by Colladon to France and sown in the Jardin de Plant, 12 of which produced trees. Most of them were sent to the south of France [and no further account of them is given], but the one that remained stood unprotected in open ground, seemingly vigorous and in good health in 1812, when it was 7 feet high, slender, with dark-green leaves in threes, about 3 inches long."

[Evidently the tree described is *P. insignis*, and there is no evidence whatever that any one collected the Torrey Pine until, as stated in Dr. Parry's historical paper, herewith published.]

The Torrey Pine is found distributed sparsely along the coast on both sides of Del Mar, in all extending a distance of about four miles. The bluff is broken in places, exposing the soft yellowish sand rock, to which the trees are found clinging, but not so numerously as on the smooth storm-beaten decline of the bluff or partially protected hollows behind it. All are apparently young trees, none seemingly over 80–90 years old, with little or no signs of previous generations. Young trees are seen in several places of all ages, but not equal in number to the present mature trees.

Query: Is this most singular species dying out, or is it just coming in?

The trees bear well when quite young—12–18 years old. Yearling cones are globular, about ½ inch thick; the second season they become ovate and 2½–3½ inches long; the third year they open and discharge the most of their seed, and the fourth season they usually fall with the remaining seed held in the lower fully developed scales, leaving a few of the still lower undeveloped scales on the branchlet. In this character of tardy maturity and retention of seed, this pine is closely connected with the classical *Pinus pinea* of the Greeks, and the one chiefly alluded to in ancient references to the pine (in Greek *pitys*).

SPECIAL STUDIES OF THE TORREY PINE.

There are on the heights back of Del Mar, in broken ravines, some dozen trees not in good condition, however, with several dead trunks that have recently succumbed to the effect of unusual water-washings of the soft rock.

Of the northern ravines the first contains 5 trees, all somewhat decrepit; the second ravine contains 19 trees, about one half of them young—from 6–10 years. One tree on the tableland, a few feet away from the ravine, and about 150 feet above the sea, is 3 feet 2 inches in circuit, 18 feet high, and about 25 years old; fruit sparse; condition good; leaves persisting upon 2-year old stems, and very large, 9–12 inches long.

Another tree, clinging to the south side of the ravine, is 2 feet 8 inches in circuit, 23 feet high, and appears to be about 20 years old. Fruit sparse,

one 2-year-old cone, four yearlings, and three infants. Leaves abundant and strong.

A third tree, in the upper end of the ravine, altitude 200 feet, in loose soil, is 1 foot 8 inches in circuit and 30 feet high, being protected in its growth. Appearance bad, apparently succumbing to environment.

The third ravine contains fifteen trees, five of them under age, with a few dead ones, killed, perhaps, by accidental fires.

A tree, near the upper end, on the floor of the gulch, well anchored in the loose sand rock, was last season a fine round-topped tree, filled with cones, but killed recently by an accidental fire, to the great regret of the owner of the premises. This is the largest tree in the north region; 4 feet 11 inches in circuit, 25 feet high, and must have been in good condition when attacked by fire, for it still retains sixty-three two-year-old cones.

Lower down in the ravine about 150 yards from the high water line and quite near the railroad track stands a fine tree 3 feet 6 inches in circuit, 25 feet high, about 25 years old. Condition good, but being quite accessible, the cones are removed as soon as formed.

The fourth ravine contains sixteen trees mostly of full age and in fair condition. Some apparently dying out from causes that it would be interesting to study.

The fifth northern locality noted for this limited tree is the south steep bank of the San Dieguito River, where sixteen trees are found clinging to the half exposed rock. On several trees cones in triplets were seen, indicating, in connection with vigorous appearance and large leaves, that this is a favorable region for best results, the perfection of seed.

A few trees maintain a feeble existence in pasture lands across the low tide water river on the north bluff but, practically, the San Dieguito limits the trees in this direction, about two miles north of Del Mar. South of Del Mar about 1½ miles, on the ravines that fall into the Soledad River, and upon the bluffs beyond, are collected the largest number of trees; too numerous and distributed for easy determination, but not above a few hundred individuals in all. The region is a gradual incline from a sheer bluff beetling over the surf to an elevation ¼ of a mile inland of 400–600 feet. It is, like all the other stretches of this beach, broken here and there by recent excavations.

On the exposed slopes towards the sea these trees are crouched as though stealthily beating their way athirst to reach their arms into the raging flood; or they may be resisting extirpation. Unwilling to leave the sacred soil of their ancestors, they suffer themselves to be beaten prostrate before releasing their strong hold of the ground.

However this is, their condition is most robust and their fecundity most abundant and successful. Here are found the best bearing trees with cones of the largest size with largest seeds. Some trees that creep along for 20–30 feet, their bowed limbs often overlaid with soil, send up here and there stout, short branches that are loaded with whorls of heavy cones, from the sand-covered base to the leaf-tufted summit. And young trees, even seedlings, are met with on these wind exposed slopes in greater number than elsewhere.

Surely this Torrey Pine loves the sea, and clings to its water-nourished confines with wonderful tenacity, like a reckless warrior fighting for vested rights. In the sheltered cross ravines, a few rods back from the sea, the trees become tall, and even stately, though here also are exhibited greater signs of decrepitude.

No. 15.—*Pinus Torreyana*, Parry—Torrey Pine. "Torrey's Crown," back of Pine Point. Bluffs of Del Mar, near San Diego. Alt. 600 feet.

Several dead and dying trees are met with, but all seem of the present generation. No holes in the sand or mounds of up-turned earth were detected in all the region, indicative of long gone generations.

Young trees were noted in several localities, some just struggling above the grass and flowers. Spade holes here and there show that trees have been lately removed for cultivation; also a few stumps are seen, but generally north and south throughout the groves the trees seem to have been allowed to remain unmolested. Notwithstanding this happily untouched condition of these trees, with the influx of immigration this lovely seaside resort of Del Mar is destined to receive a large population, and then these trees will be menaced with extermination at the hands of men, unless steps are taken to protect them, as suggested in the closing paragraph of Dr. Parry's historical paper, hereafter cited; or better, they should be preserved by the State of California through the effort of proper legislation, and the State Board of Forestry is the proper party to look after the matter.

Torrey's Pine.

By J. G. Lemmon, in "Pacific Rural Press," of April 28, 1888.

Scientists the world over and lovers of nature generally will be interested in an investigation now going forward concerning the life history, and habits of California Pines, including the rare and curious Torrey Pine—*Pinus Torreyana*—on the coast of Southern California.

A mournful interest attaches to this pine, from the fact that there are but few trees of it left, and these in a certain locality limited to a few miles of the sea coast hills, at and on both sides of the beautiful and newly established watering-place of Del Mar, San Diego County, through which town passes the Atchison and Topeka Railroad, from San Bernardino to San Diego.

The bluff or mesa at Del Mar is high and unbroken for two miles, but about two miles distant, on each side, occur cañons and breaks in the mesa, and on the sides of these cling the few Torrey Pines, for the most part gnarled and beaten prostrate by the buffeting winds from the Pacific.

On the sheltered inner side of the hills, and on the spurs of the cañons, however, the trees remain erect, and here are found the largest specimens, a few trees measuring nearly two feet in diameter, and elevating their flatened crowns to a height of thirty to thirty-five feet.

The trees are prolific bearers, the cones of three different years' origin being found abundantly on most of the trees; these, when mature, the second year, are above the medium size, four to five inches long, ovate, with few large, thick scales, terminated by short, strong, but not formidable prickles.

The nuts are very large, nearly an inch long, but slightly flattened, brown, with a narrow, thickened, black wing. The shells are thick and hard, requiring a smart blow with a hammer to fracture them. The seeds are very oily and delicious to the taste.

The pollen-bearing or male flowers are terete, very large, two to two and one half inches long and three eighths of an inch in diameter.

The leaves are in fascicles of fives, very large and strong—the strongest pine leaves known—and are six to twelve inches long.

In many respects this species of pine stands alone among California conifers. No other species is found within fifty miles of it; none other survives such buffetings by the sea winds, and no other bears such large flowers, hard nuts, and such strong leaves.

The trees are comparatively rapid growers, individuals two feet in diameter being often not more than forty or fifty years old.

In the few localities young trees of all ages are found, but always less in number than the older trees, from which it is inferred that the species is slowly succumbing to its environment, and must, if not protected, soon become extinct.

As the visitor for the first time views this curious pine, he is struck by the persistence of its character, and the suggestion at once occurs that this is the species of pine from which most might be expected by planting it along the now deforested coast hills of California.

Seeds will be sent for propagation to the Forestry Experimental Station at Santa Monica, and no doubt in a few years trees from there may be had for trial on proper application.

Historical Notice of Pinus Torreyana.

[By its discoverer, Dr. C. C. Parry.]

Read before the San Diego Society of Natural History, Nov. 2, 1883.

In the spring of 1850, when connected with the Mexican Boundary Survey, my attention was first called to a peculiar species of pine growing on the Pacific Coast at the mouth of the Soledad Valley, San Diego County, by a casual inquiry from Dr. J. L. LeConte, the distinguished American entomologist, then staying in San Diego, asking "what pine it was growing near the ocean beach at that locality?" Not having any specimens to show, he simply mentioned at the time its dense cones and its long, stout leaves, five in a sheath. Not long after an opportunity offered the writer for a personal investigation, having been ordered by Major W. H. Emory to make a geological examination of the reported coal deposits on the ocean bluff above Soledad.

In making a section of these strata (see report of the Mexican Boundary Survey, Vol. I, Part 2) it was necessary to follow up some of the sharp ravines that here debouch on the ocean beach, and here (possibly to the neglect of strict geological duties) my attention was taken up by this singular and unique maritime pine, which, with its strong clusters of terminal leaves and its distorted branches loaded down with ponderous cones, was within easy reach of botanical clutch. From the notes and collections there made a description was drawn up dedicating this well marked new species to an honored friend and instructor both of Dr. LeConte and the writer, viz., Dr. John Torrey, of New York, as *Pinus Torreyana*, Parry.

Of the few specimens then collected a single cone and bunch was sent to Dr. Torrey to be figured for the Mexican Boundary Report (Vol. II, p. 10, pl. 58-59). While there it fell under the notice of some inquisitive botanist, who extracted some of the loose seeds, which were planted, but by some inadvertence were mixed with another three-leaved species. When growing the two different kinds became confounded, and it was inferred that the present discoverer was mistaken in regarding this species as five-leaved.

Professor Parlatore, the elaborator of *coniferæ* in Candole Prodromus, added to this confusion by ignoring the name first proposed and substituting that of *Pinus lophosperma*, but fortunately the earlier publication of the Mexican Boundary Survey, with an accurate figure, permanently fixed the name of *Pinus Torreyana*, Parry, thus commemorating one of our most honored American botanists by association with a tree peculiar to the

Pacific Coast, in a region which had been so often enriched by his early botanical labors as a collaborator.

Subsequently frequent collectors have visited this locality, bearing away to the remotest portions of the world seed of this pine, which, as far as is known, is exclusively confined to a coast line of not more than four miles, lying between San Dieguito and about a mile below Soledad, and extending scarcely a mile inland.

The bulk of the tree growth is here mainly confined to a series of high broken cliffs and deeply indented ravines on the bold headlands overlooking the sea south of Soledad Valley, and within the corporate limits of the town of San Diego. Here, within a radius of not more than half a mile, this singular species may be seen to the best advantage, clinging to the face of crumbling yellowish sandstone or shooting up in more graceful form its scant foliage in the shelter of the deep ravines, bathed with frequent sea fog. One of the finest specimens seen reaches a height of nearly fifty feet and shows a trunk eighteen inches in diameter at base.

Thirty years after this first discovery (to wit, in the fall of 1880), the writer visited this locality for the second time, accompanied by the well known botanist, Dr. George Engelmann, of St. Louis. At that time more complete examinations were made, and sections of a trunk over one foot in diameter were procured and sent to the Forest Commission of the Tenth United States Census.

Here, perhaps, personal mention might properly close, but this evening, in the presence of the members of a Natural History Society in San Diego, I may be pardoned a further digression. Only a short time since the writer again visited the locality, aided by the liberality of the California Southern Railroad Company, whose track makes this fine resort easily accessible by barely an hour's travel from San Diego. Here, seeking shelter from the fervid rays of a February sun under the scant shade of a decrepit forest monarch, listening to the sullen dash of the Pacific waves against the bold shores, among other unmentionable thoughts suggested by the inspiring scene and its past associations, one floats uppermost like drifting seaweed and finds a fitting expression here. Why should not San Diego, within whose corporate limits this straggling remnant of a past age finds a last, lingering resting place, secure from threatened extermination this remarkable and unique Pacific Coast production so singularly confined within its boundaries; dedicating this spot of ground (utterly useless for any agricultural purpose) forever to the cause of scientific instruction and recreation, where wiser generations than ours may sit beneath its ampler shade, and listening to the same musical waves, thank us for "sparing this tree?" And finally, why is not the San Diego Society of Natural History the suitable body to recommend such action?

Pinus Torreyana on the Island of Santa Rosa.

[Letter from the Discoverer.]

San Francisco, California, September 26, 1888.

J. G. Lemmon, *Esq.*, *Oakland, California:*

Dear Sir: I will answer your questions about *Pinus Torreyana* as well as my memory will allow. The soil in which they grow is a mixture of earth and loose rock, or sometimes earth of some thickness resting upon solid rock. They grow on a bluff of the eastern end of Santa Rosa Island, at an elevation of about five hundred feet above the ocean, and quarter of a mile from it; the extent of the habitat is in length about one quarter mile, and number of trees about one hundred. They are erect and of all sizes up to thirty feet

high. I saw no dead trees, and the living appeared to have excellent health, and plenty of young trees were growing vigorously.

No remains of any sort that indicated destroyed trees were noticed.

Any other information (if I can) about the habitat of the tree will be gladly given.

Yours, much obliged,

T. S. BRANDEGEE.

[The above announced discovery was made in June of the present year (1888), only a rumor of the existence of the tree as being "on the Channel Islands" being in our possession before.—J. G. L.]

CLOSED-CONE PINES.

GROUP 6. LONG-CLOSED-CONE, SLENDER PINES.

Cones in verticils or clusters of 2–7, often more than one set on the same year's shoot; usually strongly declined, hard, heavy, oblique, and gibbous, on account of the outer scales near the base bearing strong knobs or tubercles, but unexpectedly, these not perfecting their seeds; the rest of the scales flat, or nearly so, and bearing the perfect seed. The cones are usually long-persistent, and *serotinous*, *i. e.*, they remain long-closed, retaining the small, rough, or tuberculated seeds, with their vitality unimpaired for an indefinite number of years. Leaves of medium size, 3–6 inches long. Male flowers very small, on branchlets with leaves above them, like the Australian Bottle-brush.

Small trees, mostly crowded into dense groves, hence, tall and slender; but broad-crowned or rounded if unrestrained.

MONTEREY PINE.

No. 16. Pinus insignis, Douglas.—Monterey Pine.

The beautiful Monterey Pine, overrunning the but recently wind-blown sand dunes, has been the subject of much confusion and controversy by collectors and botanists for the last hundred years, and it came so near receiving other names than *insignis* that its early history is very interesting.

Owing to the accessibility of this pine—right by the embarcadero of the first known harbor of the coast—many a voyager over the "South Sea" collected a few cones for souvenirs of the strange land visited, and usually mingled them with others collected at different points from the Mexican Gulf to the Oregon River.

The earliest name bestowed upon a California tree was given over a hundred years ago (1787), published in Loudon's Arboretum in 1844, and its history given as follows:

"*Pinus Californica*, Loiseleur, grows near Monte del Rey, New Albion, North America. A cone gathered by Colladon [elsewhere spelled Collignon], the gardener belonging to the expedition of La Perouse [elsewhere "Carouse"], was sent to the Museum of Natural History at Paris in 1787. The cone was of the form of *P. pinaster* [in that case narrowly oblong], but was $\frac{1}{3}$ larger in all its parts; leaves in pairs and triplets; seeds of the size of *P. cembra* [the stone pine of Central Europe, with seeds $\frac{1}{2}$ inch long and $\frac{5}{16}$ thick], and good to eat.

"Seeds from this cone [?] were sown in the Jardin de Plants, and 12 plants in due time sprouted and grew very well in the orangery. Most of them were sent to the south of France; one remaining stood unprotected in the open ground, seemingly vigorous and in good health. In 1812 this tree was 7 feet high, with slender, dark-green leaves 3 inches long."

Evidently this description indicates a mixture of our Monterey Pine with the large seeds "good to eat" of some other tree, probably one of the Nut Pines, or possibly of the TORREY Pine, but the *planted* seeds produced the Monterey Pine without a doubt.

During the years 1825-1835 great activity was displayed in obtaining scientific knowledge of the flora of the northwestern part of America, Douglas reaching the California coast at Monterey in December of 1830, Coulter in 1831, and Nuttall in 1835.

Owing to the untimely death of Douglas, on the Island of Haiwaii, Coulter's specimens were received at home first, and were described by David Don, who read his paper upon "Four New Pines from America" in 1835, before the Linnæan Society of London, which published the paper in their transactions in 1837.

One of the new pines was named *Pinus radiata*, and Don's description is as follows: "Found by Dr. Thomas Coulter about Monte del Rey. Trees grow to the height of one hundred feet, with a straight trunk feathered with branches almost to the ground. Timber excellent" [he continues, of course receiving his information from Dr. Coulter], "and admirably fitted for making into boats, for which purpose it is much used."

The cone only was figured in the transactions, and the description had no reference to leaves, seeds, or other organs, and it is worthy of note that two of the other pines published with this, viz.: *tuberculata* and *muricata*, were described on very meager characters, also cones alone being figured.

Lambert, in his great illustrated work on the conifers, published in 1842, still described the Monterey Pine as *P. radiata* of Don, and, with the other pines collected by Coulter, gave Don's descriptions.

Loudon, in his Arboretum, Vol. IV, 2d ed., 1844, first published a pine from Monterey, as follows:

"*Pinus insignis*, Douglas, the 'Remarkable Pine.'" A good description is given of our tree and its locality, but the cone figured is quite small, and the leaves are represented incorrectly. Owing, perhaps, to the misplacing of Douglas' labels, the locality of this pine is indicated by another name, "Oregon Pitch Pine;" or, more probably, the pine so called was our *P. tuberculata*, which Douglas thought he collected in Oregon.

In 1878 (I think) Dr. Engelmann, who was giving his powerful, discerning attention to American forest trees, went over to Europe to examine original specimens in the herbaria, especially anxious to clear up the nomenclature of our MONTEREY Pine. As the result of diligent search and comparison, on his return he adopted the name of *P. insignis*, Douglas, and so published it in his masterly "Revision of the GENUS PINUS," in 1880.

There are botanists of reputation who believe that early mistakes should be overlooked, and that a description, if nearly correct, should hold good with the names applied also; such think that Loiseleur's *Californica* should still be the name of the Monterey Pine.

Engelmann says, in Bot. Cal.: "Much interest attaches to this species * * * because it is probably the old *P. Californiana*, which has never been identified, but was said to come from Monterey, but seeds described are too large," etc.

Because Don's name of *radiata*, meaning the Radiate or Spreading-coned Pine (or, as given in some works, the "Radiate-scaled" Pine), inasmuch as it was described correctly as far as the description went—including the principal organ relied upon in classification, to wit, the fruit—his name of *radiata*, I think, should still be the name of the Monterey Pine in preference to one accompanying descriptions of mixed specimens like Loiseleur's, and also in preference to one of nearly full characters

to be sure, but published later, as was the case of Douglas' *insignis*—Don's description of *radiata* antedating Loudon's of *insignis* some seven years. And the minor parts of Douglas' descriptions given are not free from discrepancies—owing, no doubt, to misplacement of labels—as instanced by the two localities given for the pine and the two very different vernacular names for the species.

Beautiful as it is, and appropriate as it is, the name of *insignis* for our MONTEREY PINE finds lodgment in the majority of authors' publications, it appears, principally upon the arbitrary, but permissible, selection of it by such preëminent authorities as Dr. Engelmann.

VARIETIES OF MONTEREY PINE.

Variety (*a*) *radiata*, Don—Spreading-Cone Pine: The large-coned form of Monterey Pine, with shorter, thinner leaves than the typical. Mostly southward from Point Pinos. This form, as *P. radiata*, Don, was described from large cones "five and three fourths inches long by three and a half broad at the base, which was gibbous, with large tubercled scales." According to Gordon ("Pineturn," page 282): "This beautiful pine (*radiata*) resembles *P. insignis* in some respects, but differs very much in foliage and cones, the leaves of *insignis* being much longer and stouter than those of *radiata*, while the cones of the latter are three times the size of those of *insignis*, and with scales much more elevated," etc., characters which distinctly distinguish a form of this pine mostly found to the southward of Point Pinos, where Coulter first collected it. Therefore, for all these considerations, I have in these papers taken up Don's name of *radiata* and applied it as above to this marked variety, as, doubtless, it was first so used.

Variety (*b*) *levigata*—Nearly Smooth-Cone Pine: Cone smaller, and shorter than the typical, and scarcely tubercled. Outlying trees of the Monterey forest, farthest from the sea. This form detected lately on the outskirts of the forest is quite marked by its small size, long, slender leaves, its few cones nearly ovate, and often with no raised tubercles; the prickles also small and weak. Being, then, nearly smooth, as compared with the typical form, this may be given rank as a marked variety, as above.

The Monterey Pine grows very rapidly, trees now covering the part of Point Pinos, called Pacific Grove, averaging about 2 feet in diameter, while they are only 20–30 years old. Early settlers tell of riding over the promontory at will, unobstructed by trees, although a forest of large trees clothed the southern part of the present pine region at the time. A few of this older generation still survive, often showing injuries by fire kindled by Indians; but upon cutting into them it will be found that these, too, were rapid growers—trees 4–6 feet in diameter displaying only 80–90 rings, with those near the center a half inch or three fourths, and even a full inch thick.

John Myers, who was associated with Hartweg and with Lobb in their discoveries about Monterey in 1846–1850, still resides at Monterey, and has full recollection of early events. He states that a person named De Graw, owning a wharf where now is the Chinese fishing beach, erected a sawmill near the vicinity about 1850, which in 1856 was removed to an interior locality—Sawmill Gulch—where all the valuable timber was soon cut off, manufactured into lumber, and, according to J. O. Johnson, of Pacific Grove, some of it was shipped to San Francisco for constructing its early wharves, sidewalks, etc.

Of course this was at a period when the hard lumber pines of the interior were unknown, and the monster redwood, but a little way northward, was only beginning to be cut by a factory located near San Rafael.

The illustration is taken from a small, solitary tree, near the lighthouse at Pacific Grove.

Ever since the landing of the Franciscan padres at Monterey, in 1770, the lovely grove of dark-green pines has been much frequented by lovers of the beautiful and good. For a charming presentation of the beautiful and religious sentiments and associations connected with this noted pine, I am deeply indebted to the accompanying contribution from the gifted pen of a well known authoress:

Under the Pines at Monterey.

Contributed by Mrs. M. H. Field, of San José, California.

"The groves were God's first temples." Far back in Hebrew history we find the prophets crying out against the high places of Baal and the groves of Ashtaroth, evidently once sacred shrines then degenerated into abodes of idols and scenes of devil worship. The old Greek had his oaks of Dodona and shady haunts of Delphi, while every wooded knoll was the home of a god. The Romans set up the Greek gods beneath their own olives and cypresses. Men may still retrace the steps of Him who loved to walk upon the Mount of Olives for prayer and meditation, and the oak forests of Britain and of Scandinavia were the haunt of David and of prophetess.

The beauty and the inspiration of Gothic architecture lie in its close resemblance to the upspringing arches of a great forest, and are felt by every human heart. A tree with its uplifted arms and sun-crowned head seems an embodied prayer, and we can scarcely stand beneath one unsolemnized. The trees preached better than the preachers in the camp meetings of the last century, and it is a pity our roofs so shut them out. Every primitive community has been swayed powerfully by these great outdoor meetings, and that grand pioneer church, the Methodist, has always wisely laid hold of this element of strength. Thus it came about that the early fathers of Methodism on this coast, where outdoor meetings are so smiled upon by nature, made the camp meeting a prominent feature of their work. They were not long in finding out that the south side of Monterey Bay had a rare natural adaptation for this use. Here was the wide forest; here was the solemn sea; here was the rainless sky. Like Abram of old, the preacher "pitched his tent there, and there he builded an altar unto the Lord, and called upon the name of the Lord." It has remained there ever since, and the atmosphere still has an element of consecration as perceptible as the salt breath of the sea, or the fragrance of the forest.

Another great popular movement, the Chautauqua Literary and Scientific Circle, took its rise in a camp meeting, a true daughter of the old Anglo-Saxon "folk mote," at Chautauqua Lake, New York. It has spread all over the United States and Canada, until every State has its "Summer Assembly of the C. L. S. C.," where a veritable "Grove of Academe" is metamorphosed out of some ordinary group of elms, or oaks, or pines. The California Chatauquans found this beautiful Point Pinos, at the south side of Monterey Bay, already occupied and made ready for their use by the Methodist pioneers. They had only to come with tent and note-book, and take possession. Very pleasant were those days of '79 and '80, when tents were in the ascendancy, and cottages an aristocratic and disapproved of

intervention. But those days have gone forever. The cottage and villa have won the day, and the woodman's ax is doing its ruthless work of "improvement." Yet the pines are not wholly exterminated, thank Heaven! Still, the approaching stage seems to be carrying its occupants into some green and sylvan wilderness, and one can lose the sight and sound of humanity in a few moments' walk.

Oh, these beautiful, mournful, music-haunted pines. They clothe the whole long promontory with a garment of loveliness. Wherever they have been undisturbed they spring up in tall, straight groups, and so mingle branch with branch, and top with top, as to shut out the sunshine and almost hide the blue, over-arching sky. But fire and tempest, and the destructive ax, have thinned out their ranks until open spaces and broad vistas are the rule and not the exception. The ocean gleams in every picture, and its voice rises majestically over every other sound, but the murmur of the pines may always be heard in soft antiphonal response. The one voice is awe-inspiring, the other soothing and comforting. The one crushes with its relentless power, the other lifts up with its whispers of hope and courage. The mighty sea winds toss the pines rudely and the salt spray dashes over them, but they rise again with undying bravery, like a dauntless human heart.

On a sunny day nothing can be more exhilarating than a walk among these pines. The flickering shadows lying on the elastic mass of fallen needles which soften the path, the twitter of birds, the gentle whispering forever going on overhead, the perfect greenness of the forest tints, the lovely balsamic odors, all combine to charm the saunterer; but on a gray or rainy day the Monterey pine is wonderfully sympathetic. A weird sadness seems to have seized upon its spirit. It sighs and moans. It drips slow tears upon the traveler, or upon his roof, and the long pennons of moss, with which it has decked itself, wave like signals of distress. Sometimes in moonlight the spirit of the pine seems cheerful, or at least clothed with tender sentiment and a silvery smiling content, but on a dark, starless night, one would need a clear conscience, with no haunting spectres of remorse, or even of sorrow, to enable him to enjoy the companionship of these black robed figures with uplifted hands and disheveled hair. Yet in storm or sunshine, by day or by night, no tree was ever more individual, or more alluring, than the Monterey pine, and no grove ever had greater charm than that which fringes the beautiful bay, whose first navigators, nearly three hundred years ago, gazing with delight upon the verdure crowned cliffs, named them "Monterey," the King's wood—a fit domain, indeed, for a true king.

(Mrs. Field's rendering of Monterey into English, as "King's wood," seems incorrect, but is not. The word—mons—in Latin means a mountain, or elevation, but in Spanish "monte" has the added signification of a wood or forest, and Monterey is a Spanish word.—J. G. L.)

KNOB-CONE PINE.

No. 17. Pinus Tuberculata, Gordon.—Knob-Cone Pine, Sun-loving Pine.

Travelers in the but recent stage-coaching days of Northern California, who were whirled along the gorge of the clear, upper Sacramento, winding in and out about the spread toes of the foothills of the Sierra, may have noticed what is now clearly observed from the car windows of the railway—long frettings or fringes of small, slender, close set pine trees decorating with light-green banners the copings of the rounded mountains, especially

No. 15.—(*bis.*) *Pinus Torreyana*, Parry.—Torrey Pine. Prostrate on the slope towards the ocean. Bluffs at del Mar, 20 miles north of San Diego.

on the east side of the river, and extending from the locality of the present town of Redding to the immediate slopes of Shasta.

These long fringes, and in places more compact patches of trees, compose the headquarters of the curious KNOB-CONE PINE, associated in places with YELLOW PINE, GRAY-LEAF and SUGAR PINE, but always to be distinguished from them at sight on account of its small size when coming into bearing, as well as by its peculiar, sun-exposed position.

Its first near neighbor, while yet in sight of the floor of the Sacramento Valley, is the round-crowned, solitary, dwarfed GRAY-LEAF PINE; farther up on the sides of the sloping hills, just below the KNOB-CONES, are seen the dark-green spires of small YELLOW PINES, but the little KNOB-CONE must climb to the upper tables, elevated 3,000–6,000 feet, before it intrudes upon the severe, majestic presence of the gigantic SUGAR PINE.

In the lower foothills often a solitary sprawling-branched tree, or rarely a small group of them, has fallen from or been torn away from the copings and precipitated to the nearly level intervales along the river's course; but more frequently a sturdy individual clings tenaciously to a friendly rock jutting out of the mountain side.

These waywards or outcasts, as the case may be, are far from being unfortunates, so far as appearances go, for no trees display more greenness than they, nor more whorls of shining cones circling body and limbs.

These isolated trees or small groups of generally round-headed specimens, being nearest the usual line of travel, have generally been the most observed by the thoughtful traveler, and he often carries away a more or less incorrect idea of the true, normal habit of this tree.

In favored situations the KNOB-CONE forms quite extensive and exclusive forest areas, swarming so thickly upon the locality as to render them slim and tall, sometimes no larger than a walking stick, but even then closely and regularly studded from base to apex with whorls of long, narrow, curved strongly declined, leather-brown cones.

Trees in this last condition have won for the species the inappropriate appellation of "SCRUB PINE," but in many localities I have measured trees that were 100–150 feet high and 2–4 in diameter, with full-fruited, outreaching limbs.

The striking peculiarity of this pine, one that arrests immediate attention at sight, is the presence of all its yearly crops of cones, the oldest gray and weather-worn, the youngest shining with yellowish green luster. They seem never to fall away or to open at maturity, naturally, yet I have occasionally found a cone upon a peculiarly exposed, lower part of a trunk with its long, strap-shaped, brown scales turned stiffly backward, releasing the scattered seeds.

This persistence of cone, most marked in the trio to which KNOB-CONE belongs, coupled also with the firm coherence of their scales for an indefinite length of time, is an important and very suggestive fact, for it is connected doubtless with the better propagation, if not the very existence, of these species. It is found that the seeds in these long-closed cones are always in good vital condition, however old the cones.

Dr. Engelmann records: "Seeds of closed cones two to eight years old when I collected them, and then kept four years in a hot garret, germinated freely with Professor Sargent of the Arnold Arboretum, at Cambridge."

As stated, rarely is a cone found open, and consequently its seeds cast out, yet the traveler may find whole groves with their cones opened throughout the trees, but this phenomenon is only seen where forest fires have swept through the groves, leaving only blackened trunks and leafless branches, while beneath, on the cleared ground, may be seen hosts of seedling pines

bravely lifting their little whorls of cotyledons to view, and declaring not only that this species of tree shall be its own survivor, but also that it may extend its domain over other territory thus cleared of trees which have departed, leaving no sign.

So we may expect that though the improvident or wanton conduct of man, while it destroys by fire the noble SUGAR and YELLOW PINES of our vast forests, yet shall it not compass the extermination of *all* the family of pines, for, here and there, well distributed over the Coast and Sierra Mountains, this cunning little provident tree, fighting now for room to stand upon, and crowding close together for greater strength, shall, after long waiting and at last fire-killed, triumphantly unlock its mysterious caskets of stored life-germs and scatter them with sailing wings on the wind to reforest the mountains indeed, but with a species of pine at present development, almost worthless to man.

PRICKLE-CONE PINE.

No. 18. Pinus muricata, Don.—Prickle-Cone Pine, Swamp Pine.

The PRICKLE-CONE PINE is a peculiar species, with one exception (*P. contorta*), more than all others loving the low coast swamps of our State.

Its headquarters of development are just south of Cape Mendocino, on the Sonoma coast, from whence it extends southward to Point Pinos and the Santa Lucia Mountains. It was the farthermost outlying dwarfed specimens of this swamp pine, and not the large typical form, that Coulter discovered, in 1831, on the mountains near San Luis Obispo. In that far southern and consequently warm region, a comparatively cool climate agreeable to this coast-loving tree could only be attained by finding an elevated swamp, and such was the locality discovered by Dr. Coulter.

Don's description of Coulter's discovery reads: "Discovered by Dr. Coulter at San Luis Obispo, in latitude 35 degrees, altitude 3,000 feet, and 10 miles from the sea. Trees straight, stunted, not exceeding 40 feet high. Cones smallest of the section to which it belongs (*insignis*, *Sabiniana*, *Coulteri*, etc.), and remarkable for the very great development of the scales at their external base."

Hartweg, fifteen years later (1846), found "a small grove about a half mile square on Point Pinos, about 2 miles from the sea." This locality being so small, has rarely been found since. Last month (September, 1888) Mr. F. N. Gomez, an early and enthusiastic resident of Point Pinos, at my urgent request made diligent search for this small spot in the dense forest and with success, forwarding duly to our herbarium good specimens, undoubtedly gathered from Hartweg's locality, and determining that it is about 200 feet above the sea.

In Marin County, at Tomales Point, it approaches the sea to within a few hundred rods, growing "in the most sterile soil."

Further north, in the peat bogs of the Sonoma coast, it reaches its highest development, attaining often 80–150 feet, with proportionate expansion and vigor.

There is little of special importance, aside from the natural history of this species, to mention, after we have discussed, as in preceding pages, the peculiarities of its two fellows of the persistent and long-closed cone group. It might suffice to say that this tree differs in appearance from the others, mainly in its low, wet, marsh-loving habit, its small egg-shaped cones, with permanent prickles, and its leaves always in pairs.

One point connected with its development may be brought out in a few words, and first by comparisons.

We have shown that the elder member of this warrior band, the MONTEREY Pine, is now busied in overrunning the but lately wind-blown sand-hills of Point Pinos, battling right and left with the obstacles of its environment, and giving quarters only to another ocean battling tree of the oak family—the evergreen FIELD OAK. This encroachment upon and occupation of the ocean's dumpage ground is simulated at another point on the coast by a similarly aggressive tree—the TORREY Pine.

Also, we have traced the natural history of another associate—the KNOB-CONE Pine—especially in its adaptations of means to needs in the propagation of its species, and we intimated that the species disseminated here and there over both coast mountains and Sierra foothills, on the sunniest, driest, most exposed copings of mountains, where most exposed, also, to forest fires, stand the best chance, ultimately, not only to enlarge their area of occupation, but eventually to conquer all other vegetation and fall heir to the entire middle forest region.

The DWARF-CONE Pines, as shown in early paragraphs, seem adapting themselves to the holding of the alpine plateaus and passes of the Sierra against all contestants for all time; so there is but one kingdom left to be conquered—the low, maritime region observed to be menaced in a pronounced manner by one member of this trio of conquerors. The Redwood (*Sequoia sempervirens*) of limited range along the red sandstone belt, is making a brave fight for posterity, by throwing out suckers that become trees from adventitious buds in the stumps and roots.

But one other tree of the low coast region stands any chance of escape from the destruction that marks the presence of civilized man, and that is this PRICKLE-CONE Pine under discussion. This remarkable tree, with its long-persistent and long-closed fruit, which, like its congeners, is only released upon the most favorable conditions for propagation, is well distributed along the coast at lookout, picket stations, ready to press in upon uncovered ground; and so, from the snow-covered peaks of the Sierra to the wave-washed shores of the sea, whatever may become of the present noble, enrobing, supremely valuable forests, the entire pine family mostly forming them may not be cut off utterly, for one type of development—the strategetical Closed-Cone, at present insignificant pines—thrive best under the very conditions that are destroying the others.

VERNACULAR NAMES OF PINES.

In this closing paragraph another topic should be discussed—the popular or vernacular names. In the baptism of trees in our vernacular the matter is often left to the incompetent or careless observer, who, perchance, happens to reside near or among them. As might be expected, therefore, inappropriate, improper, and even decidedly bad names are often given them—nicknames, we might call them—which, as we come to know the trees better—their qualities, uses, and localities—we should correct by the substitution and persistent use of appropriate ones. The name, frequently met with in descriptions, of "Bull Pine" has been foisted into our pine literature by impudence or thoughtlessness, and the authorities have, strangely enough, accepted and repeated the epithet, despite its indiscriminate application to at least a dozen kinds of pine trees. In the preceding papers it will be noticed that inappropriate names have scarcely been mentioned, never admitted to place as present appellations.

"Bishop Pine," for our PRICKLE-CONE, swamp-loving species, is a very inappropriate name. What is its significance? For what reason applied? Merely and solely because the little outlying dwarfed specimens of this species first discovered were in the vicinity of San Luis Obispo.

"Soledad Pine," for our TORREY PINE, is another misnomer, inasmuch as the trees are found as well in the San Dieguito Cañon as in that of Soledad. The eminent propriety of changing this name to TORREY PINE is further enforced by the late discovery of the species on one of the Channel Islands, so that it is no longer in any sense the "Soledad Pine."

In the foregoing "List" and in the "Extended Descriptions," I have generally given two vernacular names to each species, one based, usually, on characters, the other on habitat or place of growth. By one or the other every tree cannot fail to be detected by the common observer, especially if he considers the other previous classifications leading up to it.

Of the importance of early selecting and thoroughly establishing appropriate popular names, I need address no words to those who have been confused by a half dozen misnomers for the same kind of tree. I remember when Dr. Engelmann was last on this coast the vernacular names gave him great annoyance, and it was proposed to him that a conference of botanists and lumbermen should examine and settle the popular nomenclature; but, owing to want of time and unity of action, the important work was left undone.

INVESTIGATION OF YELLOW PINE (*Pinus ponderosa*) AND BLACK PINE (*P. Jeffreyi*).

SOLICITING INFORMATION.

Having briefly described in the proper place the Broken-Cone Pines—*ponderosa* and *Jeffreyi*—and indicated the principal forms or varieties of them, in view of the fact that they comprise the greater part of the forests of the Pacific Slope, it was thought best to devote especial and extended inquiry to them in order to obtain all possible information concerning their history, qualities, uses, values, etc., the damages they sustain from enemies of every sort, and from fire and other elements.

Consequently, early in the present season (1888) there was prepared and distributed to mill owners and lumber dealers throughout the States of California, Oregon, and Nevada, and the Territories of Washington, Idaho, Utah, Arizona, and New Mexico, two hundred copies of the following "Circular of Inquiry," which, as being the first of a contemplated series, was denominated—

CIRCULAR "A."

INVESTIGATION OF TIMBER TREES—PACIFIC SLOPE.

To —— ——:

DEAR SIR: The California State Board of Forestry is engaged in a systematic investigation of the forests of the State, with a view to the procurement of useful information for wide dissemination in the hope of securing proper legislation for the protection or renewal of our forests.

Having been appointed Botanist for the California State Board of Forestry, for the purpose of investigating and reporting upon the pines of the Pacific Coast, especially *Pinus ponderosa* and *Pinus Jeffreyi*, the undersigned desires the assistance of all persons interested in forests or their products to aid him in making as full and correct a report as possible upon the subject in the limited time allowed for the work.

The instructions embodied in my commission specify that "the report shall comprise an exhaustive account of the geographical and local distribution, the estimated amount and condition of present supplies, the rate of consumption, the value, qualities, and uses of their wood, their habitat (place of natural growth), their biology (life history or conditions of growth), their chances for natural reproduction, the dangers threatening their extinction," etc.

This special report must be submitted to the Forestry Board before the end of the fiscal year, but other investigations and reports will be made annually until all the timber trees of the Pacific Slope are treated of—a work that may require several years—hence, any information concerning other trees will be gladly received and filed until needed.

DESCRIPTIONS.

To aid in the collection of information a few words descriptive of the trees in question may be necessary.

Most of the pines of this Pacific region are "pitch pines," that is: they belong to the large number of pines whose wood-cells contain more or less pitch or resin, rendering the timber harder, heavier, and less liable to decay than the other smaller class of pines of which the "sugar pine" of the Pacific Slope and the "white pine" of Michigan are noted examples.

The two species of pine distinguished botanically in this circular as *Pinus ponderosa* and *Pinus Jeffreyi* are those familiar trees called characteristically by lumbermen "Yellow Pine," "Black Pine," "Sap Pine," "Swamp Pine," "Bull Pine," etc.

They comprise the greater part of the extensive forests of the Rocky Mountains, the Sierra Nevada, and portions of the coast ranges, with the headquarters of greatest development in the Sierra Nevada.

The pitch pines may be readily distinguished from the white or sugar pines, which often accompany them, by observing characters of the limbs, the cones, and the leaves; viz.:

The limbs of the sugar pine are mostly near the top of the tree, and are few, large, long, out-reaching, and bearing very large, long cones—12 to 20 inches long—depending from the ends of the limbs; while the leaves are always short—about 3 inches long—and in bundles of fives.

On the contrary the limbs of the pitch pines under consideration are more numerous, often scattered along the trunk except in forests, where trees usually trim themselves to a great height. Any of the limbs may bear the cones which are smaller, 4 to 8 inches long, conical, pointing outward from the limbs in any direction and with prickle-bearing scales. When they fall away from the tree a portion of the base of the cone remains fast to the branch. The leaves are thicker, longer—often 8 to 12 inches long—and in bundles of threes.

The two species of pitch pine, which for convenience we will call Yellow Pine and Black Pine, are distinguished from each other by the following characters:

"*Yellow Pine*:" Often tall, 200 to 300 feet high, and 12 to 15 feet in diameter, with very thick, yellowish bark deeply and irregularly furrowed into large plates; the sap-wood very thick, 100 to 200 rings, almost white, the heart-wood light red, usually hard and heavy, but varying greatly in these qualities.

The Yellow Pines are distributed throughout the region described, and furnish the principal lumber of Central California and Nevada, Eastern Washington and Oregon, Western Montana and Idaho, and the greater part of New Mexico, Arizona, and Western Texas, with the near prospect of extensive consumption in regions farther eastward, owing to the gradual exhaustion of the Great Lake forests.

"*Black Pine*:" Smaller, 100 to 200 feet high, with more symmetrical, rounded or conical head, finer cleft and darker bark, larger cones and glaucous (white powdered) branchlets and leaves. The branches when freshly bruised give off an odor resembling oil of orange.

The sap-wood is usually yellowish white, the heart-wood coarser grained and usually lighter than the other pine.

The Black Pine is found exclusively on the slopes of the Sierra Nevada, especially on the eastern side.

With these descriptions in mind, there can be no mistake in distinguishing these trees from each other.

QUESTIONS.

Referring, if necessary, to the foregoing descriptions, please return answers to the following double series of questions, using other paper where the space left for answers is insufficient.

Economic.

1. Are the Yellow Pine and the Black Pine both found in your immediate vicinity, or within your county? If so, in either case, in what ratio to each other; also to other timber trees? Answer: —— ——.

2. Does the Yellow Pine described only grow in your vicinity, *i. e.*, unaccompanied by the other, the Black Pine? If so, in what ratio to other trees? Answer: —— ——.

3. What is the condition of the trees, *i. e*, are they too small for lumber purposes, or are they large enough but untouched; or are they being removed for farming purposes, to make room for crops or used for fencing, for fuel, coal making, etc.; or are they being manufactured into lumber? If the latter, state what kinds of lumber, as building

material, railroad ties, mining timbers, bridge timber, shingles, laths, etc. Answer: — —.

4. What is the output of lumber from the mills at your station, or in your county, annually? Give in feet, board measure, amount for 1887, and the value. Answer: — —.

5. In the cutting of logs at your station, or in your county, is there any limit to the size taken? If so, what is the least diameter or girth? And what is the average number of logs required for making 1,000 feet of lumber. Answer: — —.

6. In regard to durability of the pitch pines, how do they compare with other trees for resisting decay when used as fence boards? As fence posts? As weather boarding? As shingles? As railroad ties? Answer: — —.

7. Has the forest at your station or in your county been injured by fires either accidentally, carelessly, or purposely? If damaged, how greatly, during a series of years past; also during the year 1887? Give estimates in acreage of square miles or in ratio to timber left. Answer: — —.

8. Are the forest trees of your vicinity injured by attacks of insects, or by vegetable parasites, such as the mistletoe? If so, to what extent? Answer: — —.

9. Where the original forest in your vicinity is removed, what trees, if any, come in? Give age and height of largest trees, and a conjecture as to when they will be large enough for lumber use. Answer: — —..

10. What other facts or suggestions of interest can you give bearing on the subject of forests and their products? Answer: — —.

Biological.

11. In regard to growth of the pitch pines under investigation, at your station or in your county, what is the average height of trees? What is the average number of rings to the first linear foot of diameter, counting from the heart outward? The second foot? Third? etc., and what is the largest diameter or circumference you have noted, and the height of the same tree? Answer: — —.

12. What differences have you noticed concerning tree growth, depending perhaps upon differences of elevation? Or of inclination, *i. e.*, on slopes facing northward, eastward, southward, or westward? Answer: — —.

13. According to your observation, what is the altitude above the sea level for the greatest development, the most robust growth of the pitch pines? And what is the altitude of their extreme upper limit? The lower limit? Answer: — —.

14. What is the annual amount of rainfall (or of melted snow) at your station, or nearest recorded locality? And during which 30 days does the greatest percipitation occur? Answer: — —.

15. At what time does the tree flower, *i. e.*, when is the pollen disseminated? Detected by the air under the trees, being sometimes filled with yellow dust. Answer: — —.

16. Do the cones ripen and fall equally abundant one year with another? Or only on alternate years? And when was the most prolific season you have noticed? Answer: — —.

17. There being great diversity in the size of cones, what are the extremes in length of mature cones you have noticed? And what the locality, the elevation, exposure, or other conditions of the trees bearing the largest cones? Ditto of those bearing the smallest? (In answering these questions be careful not to confound the two species described.) Answer: — —.

18. Has the forest in your vicinity ever suffered from the effects of floods, or hot winds, tornadoes, or avalanches? If by either, give date and estimated damage. Answer: — —.

19. Are the trees injuriously inclined by prevailing winds, or by weight of snow? Or are any considerable number of them dying at the top, or throughout, from natural causes? Give estimate of damages. Answer: — —.

20. What other facts of interest can you can give concerning the growth or life history of the pitch pines? Answer: — —.

It is obviously of great importance that as full and accurate statements as possible shall be made, but where exact figures or data are not attainable, careful estimates may be given.

The names of parties reporting information need not necessarily be published in connection with their statements, but only condensed reports from the various stations, towns, or counties of the States and Territories.

It is not deemed necessary to urge the importance of the investigations herein contemplated; hence, your early and earnest coöperation is hopefully and respectfully solicited.

Reimbursement for expenses of stationery, stamps, etc., will be made if desired.

Address all reports or inquiries to—

J. G. LEMMON,
Botanist for the Board of Forestry,
California Hall, Clay Street, Oakland, California.

N. B.—Latest date for reception of reports, August 10, 1888.

RESPONSES.

Some of the responses are nearly complete and quite satisfactory. Others only convey meager information.

Following are a selection of characteristic responses:

Mr. Wm. B. Tiffany, Truckee, California, Agent of the Sierra Nevada Wood and Lumber Company, reports:

"I have endeavored to answer most of your questions, but I have great difficulty in distinguishing the difference between the yellow and the black pine sometimes.

Economical.

"First question—Are the yellow and black pine both found in your vicinity, etc.? Answer—Yes. Both are found abundantly in the eastern portions of El Dorado, Placer, Nevada, Sierra, and Plumas Counties of California. The ratio of each to the other varies. In some localities the growth is nearly all yellow pine, while in tracts adjoining perhaps all is black pine, but often they are mixed. Variety of soil, varying slopes, and different conditions of moisture cause a different growth of trees. The yellow pine usually grows upon sunny slopes, or upon flat bench land, preference being given always to a warm, dry soil.

"The black pine grows and thrives more upon moist land around springs and meadows, and upon north slopes adjoining groves of or intermingled with white fir (*Abies concolor*) or balsam. Black pine usually predominates on a coarse granitic soil, where the surface is uneven or rolling. Both the yellow and black are distributed about equally over the district of country above named, as to number of trees, but with reference to value and accessibility, the yellow far exceeds the black pine.

"In appearance the yellow pine is large and tall, of a spire or steeple shape. The bark is thin and of a red-brown color, furrowed into segments of large or small size and of great irregularity.

"The sap-wood is generally thin and it can be easily all removed from the heart-wood at the mill. The sap on large trees is not often more than 2 to 4 inches thick.

"The heart-wood is often very light and dry when first sawed from the tree; the color is of a yellowish cast. It is often soft and of greater value for clear lumber than sugar pine. It is generally free from pitch streaks and imperfect spots.

"The black pine does not grow as large as the yellow, the growth is more in groups and upon rocky slopes. The bark is thick with deep, irregular furrows, close together longitudinally; the sap-wood is very thick and heavy, in fact trees of two and three feet in thickness are all sap-wood, except perhaps a few inches in the center, which is generally of rather poor quality.

"Third Question—What is the size, condition, etc., and what uses are made of the trees? Answer—Yellow pines are of a good average size for lumber, from 2 to 8 feet in diameter. Black, from 1 to 5. Both are being manufactured into lumber on the Truckee River, and at Lake Tahoe, also at many other locations throughout the region described.

"All kind of building lumber, mining timbers, railroad ties, bridge timbers, shingles, laths, and packing boxes are made in this region; also much is used for fencing, fuel, and coal making.

"Fourth Question—What is the output of lumber from the mills at your station, or in your county, annually? Answer—The output of lumber on the Truckee River from the Counties of Placer, Nevada, and Sierra, State of California, and of Washoe County, in the State of Nevada, is about forty

millions of feet annually. Of this two thirds is pine, the rest white and red fir. The value of common lumber is from $8 to $12 per thousand, and from $15 to $35 for clear lumber.

"Fifth Question—In the cutting of logs at your station, is there any limit to the size taken, etc.? Answer—On the Truckee River logs are cut as small as 10 inches in diameter, elsewhere not so small logs are taken.

The average number of logs required to make a thousand feet is 2½ to 3 logs; often 2 logs will make a thousand, rarely one will yield that amount.

"Sixth Question—In regard to the durability of pitch pines, how do they compare with other trees, etc.? Answer—Pitch pine lumber is durable when it does not come in contact with the earth. For fence posts and railroad ties it is not so lasting as cedar (*Libocedrus decurrens*), and redwood (*Sequoia sempervirens*), and will decay in from 3 to 10 years. It is not much used for these purposes..

"Seventh Question—Has the forest at your station been injured by fires, etc.? Answer—The forest in this region has been greatly damaged in the past, and in some localities 2 trees out of 4 have to be cut off at the butt on account of injury by fire.

"The box business, however, which is extensively prosecuted at Truckee and elsewhere, is overcoming this former loss, and at many of the mills nearly the whole tree is sawed up and utilized for box lumber.

"The fires have been set in years past by Indians to drive or herd their game. Sheepherders set many fires wantonly, also campers, and travelers generally.

"Railroad engines occasionally fire the dry leaves and weeds along their lines, which escape to the woods, but generally much vigilance is used on the part of workmen to prevent such accidents. Rarely lightning ignites a tree, at least certain forest fires are reported to be caused by lightning.

"As the timber lands pass into the possession of private individuals the owners generally make some effort to protect the forest. While the title remains in the Government no one seems to care if the forests do burn over.

"In certain localities fires were very destructive over large areas in the year 1887. In one place several sections (mile-square plats) were burned by a single fire in one night. Seven or eight years ago a fire that started near Verdi, Nevada, from a sheep camp, moved westward for several weeks, destroying over seven thousand acres of excellent timber.

"Eighth Question—Are the forest trees of your vicinity injured by attacks of insects or other animals, or by parasites? Answer—But slightly by mistletoe and not at all, that I can remember, by insects. The dry summers and cold, snowy winters must prevent. Porcupines girdle a great many young trees in winter, when the snows are deep, to obtain food.

"Ninth Question—Where the original forest is removed, what trees, if any, come in, etc.? Answer—A new growth of the same kind of trees come in. It must be that seeds find only occasional seasons favorable to germination, as young groves seem to consist of trees of the same age. In Ormsby and Washoe Counties of Nevada, where the timber was all cut off and the ground burned over in 1866 (twenty-four years ago), a growth of very fine trees is found now, fifteen to twenty feet high, and many of them one foot in diameter. The increase of some of the thriftiest is one inch annually in diameter and two feet in height.

"Upon Galena Flat, in Washoe County, T. 17 N., R. 19 E., M. D. M., there are some three thousand or four thousand acres of fine pine trees twelve to twenty feet high and four to twelve inches thick, grown in twenty years.

No. 16.—*Pinus insignis*, Dougl.—Monterey Pine, Pacific Grove, Point Pinos, near Monterey.

"It happens that in the region last described sheep are herded through the pines in the spring season, eating all the herbs and trampling the pine leaves into the moistened earth to a depth of two or three inches. This process prevents fires from occurring anywhere in all this young forest, and, perhaps, it also improves the conditions somewhat for the vigorous growth seen.

Biological.

"Eleventh Question—What is the average height of trees, diameter, etc.? Answer—The average height of trees in the district named is 100 to 150 feet. The greatest diameter I have seen was 7 or 8 feet, those trees being about 150 feet high.

"Twelfth Question—No answer.

"Thirteenth Question—What is the altitude above sea level for the greatest development, etc.? Answer—Pines thrive best at an altitude of 5,000 to 6,500 feet at this station. Their extreme upper limit must be at about 7,000 feet, and the lower limit not far from 4,500 feet.

"Fourteenth and fifteenth questions unanswered.

"Sixteenth Question—Do the cones ripen equally abundant, one year with another, etc.? Answer—There is a vast difference in years for the production of cones and seed. Sometimes several seasons will pass before seeds that contain good kernels will be found; then, perhaps, a season comes in which the ground under the trees will be covered with cones and sprinkled thickly with plump seeds, at which seasons the squirrels and chipmunks gather the seeds, and even the cones, very industriously, burying them or hiding them away from sight. Such a prolific year occurred five or six years ago; seeds then could be scooped by handfuls from the ground.

"Seventeenth Question—What are the extreme lengths of cones you have noticed, etc.? Answer—Two or 3 inches long for the yellow pine, with the thickest and whitest bark, and 6 to 8 inches for the cones of the black pine, with thinner, darker bark.

"Eighteenth Question—Has the forest suffered from meteoric causes, etc.? Answer—In very wet seasons, if hard winds prevail, a great many trees are blown down in certain passes, or along the banks of lakes, or the sides of valleys.

"Nineteenth Question—Are the trees dying naturally; if so, the cause, etc.? Answer—Many trees are dying in scattered situations through the forest. No assignable reason for it, perhaps old age.

"Twentieth Question—What other facts of interest can you give, etc.? Answer—The Sierra Nevada Wood and Lumber Company own over 100,000 acres, to wit: In Sierra County, 25,000 acres; in Nevada, 11,000 acres; in Placer County, 12,000 acres; in Washoe, stripped of trees, 35,000 acres; in Douglas, stripped mostly, 8,000 acres. While we strive to prevent the waste or destruction of timber, we do not share the fears of some concerning the loss of present forests, and we hold our lands, untouched or stripped, at about the same valuation.

"WM. B. TIFFANY,
"Agent S. N. W. & L. Co.

"TRUCKEE, September, 1888."

C. F. Sonne, bookkeeper for the Truckee Lumber Company, reports a few additional facts from that interesting region, all statistical:

"The only firms here now who cut logs to any great extent are the Truckee Lumber Company, cutting last year (1887) about 5,000,000 feet of logs—of this one half is white and red fir, the rest pine, but I cannot

get at the ratio of yellow or black kinds; the Pacific Lumber and Wood Company cut last year (1887) 5,000,000 feet, nearly all pine—of this probably one third black pine; George Schafer cut last year 8,000,000 feet, one half of it fir and one tenth of the whole black pine—say, 500,000 black and 3,500,000 of yellow pine; the Ellen Mill Company cut a large quantity, and the Richardson Brothers, but I cannot get the figures."

Circulars and urgent letters to all of these parties were pleasantly received, and promises of replies returned, but no responses were ever made, for various reasons, mostly want of time.

H. K. Turner, representing the Turner Bros. Sawmill at Sierra Valley, Sierra County, California, reports:

Answer to No. 1: Both in about equal quantities; perhaps the black pine predominates. They comprise the larger portion of the forest growth here.

Answer to No. 3: Generally of good size, and are being cut for all domestic purposes, building lumber, fencing, etc.

Answer to No. 4: About 3,000,000 feet, valued at $30,000.

Answer to No. 5: Seldom less than 12 inches is taken. About 2 logs yield 1,000 feet; a fair estimate.

Answer to No. 6: As boards pine lumber is most desirable. Cedar (*Libocedrus decurrens*) is used here, generally, for fence posts; sugar pine for shingles; no railroad ties manufactured here yet. (Twenty-five miles from the line of the C. P. R. R.)

Answer to No. 7: Never has been much injured by fire.

Answer to No. 9: Same as original growth. Some trees 200 feet high, and perhaps 500 years old. Seldom is a tree cut for lumber that is less than 100 years old.

Answer to No. 11: Average height about 175 feet. Trees 8 feet in diameter and 200 feet high are the largest I have noticed; did not count rings; think about 250 years old.

Answer to No. 12: There is not much difference in size or appearance of trees on different slopes, etc., but the northward slopes produce the best lumber.

Answer to No. 13: From 3,000 to 5,000 feet is the best altitude for development. Upper limit about 6,500 feet; cannot give the lowest limit.

Answer to No. 16: The cone and seed product varies greatly; cannot say when or why.

Answer to No. 17: Have not recorded any observations; unable to answer.

J. D. Keefer & Co., Nord, Butte County, California, report:

1. Yes; both yellow and black pine are about equally abundant here, but as we go higher up in the mountains the yellow pine is more numerous, and it also increases in size to the timber limit.

2. We have yellow, black, and sugar pine, spruce, cedar, fir, red or black oak. The yellow and black pine compose two thirds of the forest.

3. Trees generally large enough for lumber. Very few are being removed or farming purposes, none for coal-making, or for fuel. Fencing, lumber, building, bridge timber, etc. No railroad ties, lath, nor shingles, or mining timber.

4. About 1,000,000 feet for this station; cannot say for the county.

5. Fifteen inches at the small end. About 3 logs to the 1,000 feet.

6. For fence boards, weather boarding, or rustic siding, or shingles they are No. 1; for railroad ties I can't say. Not good for fence posts; decay too soon.

7. No damage has ever been done, to my knowledge, to growing trees, that is, during the past 18 years.

8. Very slightly; hardly noticeable.

9. Sugar pine, yellow and black, and fir. From 18 to 22 years; height, from 50 to 120 feet. Some of them will make lumber within 10 years.

10. As fast as the timber is cut down, or burned off, young trees spring up and take their place. The young trees grow very rapidly, in 6 to 10 years obtaining a height of 20 to 35 feet. It seems to us impossible to destroy a pine forest, as long as fire is kept out.

11. I would say 150 feet. First foot diameter, 32 rings; second, 51 rings; third, 68; fourth, 74 rings. Largest diameter I have measured, 7 feet 8 inches, 180 feet high, 563 rings from heart to bark.

12. On slopes facing northward or northwest the trees grow more rapidly, are taller, have less body limbs, make better lumber, shingles, or shakes.

13. About 3,000 feet; (*b*) 8,000 feet; (*c*) 1,500 feet.

14: I have no means of measuring the rainfall. Cannot answer.

15. In May of each year.

16. No. Only every third year. In 1877 and in 1883; this year promises a good crop, but not so abundant as in 1883.

17. I cannot at this time answer, but will make investigations for the future. Write to me again.

18. No. From neither. We have no hot winds, and seldom winds heavy enough to damage trees appreciably.

19. No damage from wind or snow. Occasionally a tree may be seen dead on top, but I am ignorant of the cause.

20. None other at present, owing to limited time.

J. W. Snodgrass, La Grande, Union County, in the northeast corner of Oregon, reports:

1. Yes. Both are found here abundantly.

3. They are large enough for sawing; timber all in the mountains.

4. At one station probably 2,000,000 feet; in the county, probably 5,000,000 feet.

5. They must be 14 inches or over, as they run about 3 logs the 1,000 feet.

6. They are the best for all purposes we have.

7. Not to any great extent. Some years past some damage was done carelessly by Indians.

8. No. No damage to report.

9. The same kinds come in, namely, pine, tamarack (*Pinus Murrayana*) and fir. Cannot say when will do to use.

10. I would urge the necessity of more thorough efforts to prevent fires.

11. From 50 to 100 feet; the largest about 5 feet through.

12. More timber grows on the eastern than on the western slopes.

13. At our station about 3,000 feet. Upper limit, 4;300 feet. Lower, 2,700 feet.

14. Never kept a record. Time mostly in March.

15, 16, and 17. Not noticed in these reports.

19. Some are dying, probably 5 per cent.

L. C. Seaton, writing from Teanoway Valley, in Kittitass County, Washington Territory, in the west part of the country just east of the Cascade Mountains, at an altitude of 1,600 feet, in a valley of about 128,000 acres of good agricultural lands, reports:

1. Yes; both kinds in this vicinity in great abundance; about equal, comprising three quarters of the forest.
2. Yellow pine accompanied by the black pine.
3. The valley is just settling up, many mills being erected. Some will cut 100,000 feet per day. All sizes from 6 inches to 6 feet are cut and made into lumber.
4. About 500,000 feet, value $5,000.
5. Least diameter 14–16 inches; 3 logs 16–20 feet long to the 1,000 feet.
6. Our pine is quite durable; is used by railroad companies for ties, but not so durable as red fir (*Abies amabilis*).
7. Heavy fires are frequent and very destructive. During the year 1885 perhaps one tenth of the timber in this valley was destroyed, but the average would not be so great one year with another.
8. None at all.
9. It grows up to pine again. All ages and heights. It takes a pine here 100 years to grow 12 inches in diameter. [This must be an error.]
10. About one fourth of the timber here is red fir. Higher up in the mountains there is considerable cedar. Cottonwood is abundant along the streams, and also larch in the mountains.
11. Average height about 100 feet in this valley, but in the mountains it attains the height of 200 or 300 feet, with 100 rings to the foot. Largest diameter seen 10 feet.
12. The greatest growth is in the highest elevations, not much difference in slopes.
13. Greatest development seems to be at 3,000 feet. Highest limit unknown, lowest about 1,500 feet.
14. Annual rainfall about 16 inches, melted snow about 24 inches. Greatest amount of rain in November, snow in January.
15. Fore part of June.
16. Two years ago (1886) there was an abundance of cones, last year but few. Prospects fair for many this season (1888).
17. Have not paid much attention. All here seem to be of about same size, 4 inches long.
18. No damages.
19. Not injured by wind or snow. Some few, perhaps 1 per cent, from natural causes unknown.
20. No time for more facts.

RENEWAL OF PINES.

The remark is often heard when discussing forests and forest products, that they are being exhausted, that few young trees are coming on, and that the entire mountain regions of the West will in a few generations be denuded and destroyed. During my somewhat extensive explorations of these mountains for twenty years past, I have given especial attention to this subject, and I do not share these opinions, but I believe, rather, that the forest is being amply renewed, and usually, by the same trees.

Circumscribing often a certain area, I have counted the stumps thereon where trees have been removed, then counted the young trees, those that have a robust appearance, evidently beyond danger of being choked off as weaklings, and usually the number of younglings exceeded the stumps.

This, of course, alludes to examinations where forest fires have not prevailed annually. Forest fires are the great scourge of the West. Where they prevail the most painful desolation is seen. We witnessed last season a fire in Sierra County, which, raging for several days, laid bare two thousand acres of very valuable timber, and, of course, killed the young trees.

In a few instances it should be stated to the credit of certain lumber owners, that pains have been taken to clear off by fire the tree tops left where lumber and wood have been completely removed from the ground. Such a region is seen in nearly all the space between Lake Tahoe and the Carson Valley—say twenty by twelve miles. Some twenty-two years ago this land was speedily stripped by the use of flumes, down which the mining timbers, other lumber, and the wood were cheaply transported fifteen to twenty miles over a grade so steep that it would be impossible for locomotives to make the ascent, even by a road twice as long.

Having stripped the valuable lumber off, fire was systematically used to clear the brush away, and now over all this space an abundant young growth is seen, of both the yellow and black pine, ten to twenty feet high and ten to fourteen inches in diameter.

Above Donner Lake, where a flat, rocky valley was cleared of trees twenty to twenty-four years ago of principally *Pinus Murrayana*, or "Tamarack Pine," there is now no want of trees, in fact, they are many times thicker than the stumps among them.

It is true, the invaluable forests of redwoods in the coast mountains, composed of trees requiring many centuries for their growth, are being fast removed by this generation. Only the wisest legislation could prevent this calamity, for all the interests of gain and convenience are arrayed against any efforts at rescue.

But the young trees springing up so generally in the track of the devastating ax and saw, are in many places ruthlessly destroyed for trifling purposes. Indulgence annually in Christmas trees by the citizens of San Francisco and the other cities near the redwood belt, causes the sacrifice of thousands of the finest, most robust trees, at 25 to 50 cents apiece.

When Mr. Tiffany conducted us to an embowered dancing-floor near Donner Lake, a hundred feet square, we found it thickly surrounded with young pine trees, cut and placed there just for ornament, and we could but heartily join him in his mournful denunciation of the vandalism. Everywhere through the forests may be seen the most wanton destruction perpetrated by tramps, campers, and hunters, whose depredations are not restrained by law in this new country.

In all the agricultural valleys, of which there are many within the forests of the Pacific ranges, the edges of the forests have usually been removed for various reasons, and invariably the trees have tried to restore the wastage. Perseverance in their destruction to maintain cultivated fields is successful, but any neglect is seized upon at once by the negligent cone-bearers to creep into the tracks of their progenitors.

The same remarks may be made concerning the many mining camps of the Sierra. Once the picture of wholesale destruction and the monuments of a merciless greed, the uptorn cañons and mining ditches, the ruined mills and macadamized stage roads, are now overgrown by large trees and kindly concealed.

NATURAL ENEMIES.

Animals.

1. Porcupines.

Several animals prey upon trees at different ages of their growth, and in different degrees. The most destructive enemy of pines I have noticed is the Western Porcupine (*Erethizon epixanthus*).

In winter, when deep snows lie on the Sierra, these animals, which do not seem to mind the rigors of the season, come out from their hiding places in rocks, and climbing young trees gnaw off the bark from the smooth inter-nodes near the summit of the trees. Often every limb will be stripped, too, and first bleeding at every pore with pitch for a season, the trees soon die—at the top, at least. Trees are attacked and killed in this way in great numbers in certain sections.

The forests around Sierra Valley, at Webber Lake, around Donner Lake especially, and along the Truckee River to Lake Tahoe are much injured, every tree in some large areas bleeding and dying from being girdled by porcupines.

Mr. Tiffany, whose full report in reply to questions is given in another place, kindly conducted us to Donner Lake, to show us porcupine work in the "Tamarack Pines" of that region. It was a pitiful sight to behold. Hundreds of trees could be counted from any one standpoint, whitened with pitch and dying at the top, or often killed outright.

On the line of the Truckee River scarcely a young tree has escaped these marauders, and in such molested localities as these it is past comprehension that suitable steps have not been taken to destroy these animals. It seems they must have rough, rocky places for their haunts, as the open, smooth country does not show their presence.

2. Insect Depredators.

Pine trees and, in fact, all the cone-bearers, are prevented from ripening seed every year by the attacks of insects of several kinds.

Certain kinds attack the buds or the yearling cones, and they wither and fall. Others prey upon the maturing cone, and their larvæ bore through the scales from ovule to ovule, eating out the germs.

The fact that forest trees only produce seed occasionally is mainly due to these causes. A year of full crops favors insect development, which reduces fruit production, by which, in turn, it is itself checked for want of food; so these opposing forces combat, triumph, and retire alternately, and consequently the trees are intermittent in seed-bearing.

VEGETABLE ENEMIES.

Parasites.

Mistletoe.—Several species of pine mistletoe feed upon the cone-bearers, and two species in particular—*Arceuthobium occidentale* and *A. robustum*—attack the forms of yellow and other pines we are investigating. The former may be seen in limited sections throughout both the coast and Sierra Mountains. The latter is said to flourish upon the variety *scopulorum* in the Rocky Mountains.

Except where a young tree is attacked by the pine mistletoe, the destruction of the tree is not severely menaced; but where large masses of this parasite are found, and the limbs are being strangled and killed, of course a deleterious effect is produced upon the tree to the extent of the loss of so much foliage, and consequently the failure of the elaboration of a given quantity of sap.

In several sections of the Sierra forests, and in many more of the Coast Ranges, mistletoe is so abundant that the trees are very appreciably stunted in their growth, many trees that started out vigorously being now stopped and spoiled for timber, and not a few are killed outright.

Fungi.

In the same way as the unseen miasma of the lowland and the microgerms of the crowded metropolis are the most insidious and successful enemies of mankind, so certain microscopic fungi are found to be stealthily preying upon our forests, and, in some localities, to the extent of total destruction to large areas.

One of my correspondents, Eugene Semple, of Vancouver, Washington Territory, writes: "The most valuable tree here is the Yellow Fir (DOUGLAS SPRUCE) which reaches its greatest development in the coast mountains of Oregon and Washington, where it sometimes reaches a diameter of 12 feet and a height of 300 feet. * * I have noticed within the last few years small areas of dead firs occurring so frequently on the mountain sides as to be very conspicuous and of course important. I have made efforts to ascertain the cause, but am still ignorant of it; probably due to ravages of insects."

Mrs. M. A. P. Ames, of Auburn, California, writes: "Our two species of pines—*Sabiniana* and *ponderosa*—are much affected this season, the damages seemingly more and more evident with each passing year by that recently described fungus of Dr. Harkness. It attacks trees of all ages, but especially young ones, forming rings or swellings on the limbs. The *P. Sabiniana* suffers most. Often nearly every tree of a grove will be diseased, and dead ones are seen on every hand."

The two enemies whose work is thus described by my correspondents are types of several fungi that are preying upon our forest trees. The first mentioned has been investigated by Dr. Harkness, President of the California Academy of Sciences, and named by him *Dædalia vorax*. The second was named by another microscopist in his honor, *Peridermium Harknessii*, Moore. This is an orange colored fungus that in the spring months attacks its victims, and we have observed every twig, often several knots on the same one, on a tree attacked. The mycelim of the fungus penetrating to the cambium, the tree at once commences to develop new tissue, either to arrest the invader or to envelop and encyst it. Swelling commences, generally extending all around the limb or young tree, and as the work goes on year after year, the excrescences, breaking the bark, swell to rounded knobs, generally surrounding the part affected, the sap is prevented from reaching beyond, the services of the girdled limbs in elaborating materials for the community are suspended, the limbs become hypertrophied, the struggling tree yields to fate while bravely fighting, and, like Samson, destroys his enemies by his fall.

PINE-SEED HARVESTERS.

Much could be written concerning the work of squirrels in cutting off cones, gnawing the scales therefrom at once to secure the seeds, or storing them in many ways for winter use—but space forbids.

Cross-bills.—During two winters while the writer was residing at Webber Lake, Sierra County, California, at an elevation of nearly seven thousand feet altitude, the snow being fifteen to twenty feet deep, the grove of TAMARACK PINES (*Pinus Murrayana*) in which the hotel was situated was regularly visited by a flock of the curious cross-bills (*Loxia curvirostra*) birds that feed upon the seed of such serotinous or tardily opening cones as these of the TAMARACK PINE. This they accomplish by forcibly inserting their long, sharp, incurved bills between the scales of the cones, closing the points of the bill beyond the seeds, the points passing each other and thus forcing the seeds out and into the mouth of the birds—a beautiful exhibition of the adaptation of means to ends.

Crows Eating Pine Seeds.—The cones of the black and other large-coned pines of the Sierra are attacked and the seeds extracted for food by a certain western crow—*Corvus Richardsonii*—which, feeding upon other substances at other times, turns his attention to the pine cones as soon as their seeds are sufficiently mature for food. Perching upon the limbs near the cone to be attacked, he strips up the tough scales with his sharp, strong beak, securing the seeds and leaving the cone mutilated, as far as he can reach around it from his position, leaving a mass of short, tough fibers, in place of the beautiful cones with their spiral wreaths of ornamental scales.

PINES IN LITERATURE.

ORIGIN OF THE PINE.

The origin of the pine is given thus in the Grecian mythology: Pan, the god who presided over the country and, consequently, had charge of rural objects and affairs, including forestry, had many love adventures, one of which was the attempt to win the love of a nymph of Mount Taygetus, the abode of the god. Boreas, the god of the north wind, became a rival of Pan and blew the nymph down from a high rock and would have killed her, but Pan, though unable to save her life, could change her form, so he changed the nymph into a pine tree (in Greek *Pitys*), and from that period pine trees have been seen clinging to rocks on mountain sides.

FIRST MENTION.

In the ancient writings of the Hebrews we read of the pine, the cedar, and the juniper, with some allusion to their appearance, and especially to their qualities.

The earliest descriptive writer on trees whose work has been preserved, is Theophrastus. He was the successor of Aristotle in the peripatetic school, and was born about 370 B. C. He wrote many books on a variety of subjects, the most important of which are two large botanical treatises that have come down to us, viz., *Historia Plantarum*, in nine books; *Causis* [origin] *Plantarum*, twelve books. In the *Historiæ de Plantis* he mentions

No. 17—*Pinus tuberculata*, GORDON. Knob-Cone Pine, near Shasta, on the western slopes; altitude, 6,000 feet.

the pine, giving a short description, and discusses its various products (resin, pitch, etc.), its qualities, uses, and the like; also, he writes of the abies, picea, cedar, juniper, balsam, and others. In the second treatise he gives very interesting items concerning the origin of these trees.

These treatises constitute the most important contributions to botanical science until we come down to modern times, and furnish evidence of the author's extensive and careful observation, combined with much critical sagacity.

Pliny, the elder (properly alluded to as the naturalist), after Aristotle the most learned of ancient writers, was born A. D. 23, and sacrificed himself to his devotion to science in 79, during the eruption of Vesuvius. He wrote much, one of his most valuable works being *Naturalis Historia* comprising thirty-seven books.

After discussing the animal world he writes: "It now remains for us to speak of the vegetable productions which," he states, "are equally far from being destitute of animal spirit."

A farther statement of Pliny's wise estimation of forest trees is quoted in the introduction to this investigation.

In speaking of resin trees, he writes: "Whereas there are in Asia several trees that produce pitch, in Europe there are but six varieties that supply it, viz.:"

1. The Pine (meaning the cultivated *Pinus pinea* of Linn).
2. The *Pinaster* (*P. sylvestris*, L.), which he calls "the wild pine."
3. The Pitch Tree (*Abies excelsa*, D. C.), now known as spruce.
4. The Fir Tree, with full branches, and used for ship building.
5. The Larch (*Larix Eropeœa*), our American species called Tamarack.
6. The Torch Tree, gives out more resin than either of the others (*Pinus cembra*).

Of these the *Pinus pinea* is the *Pitys* or pine tree of classical literature, both Greek and Roman.

He writes: "The pine and pinaster have long, thin leaves like hair, pointed at the ends. The pine yields the least resin of them all, in hardly sufficient quantities to warrant us in reckoning the pine among the resinous trees."[!]

"The Pinaster," he reiterates, "is nothing but a wild pine. It rises to a surprising height, and throws out branches from the middle just as the pine does from the top. This tree yields a more copious supply of resin than the pine."

He speaks of it as growing in flat countries like another that "is found along the shores of Italy" (a variety of *P. Sylvestris*).

"All these trees," he continues, "are evergreens" [not so the larch] "and not easily distinguished by the foliage even by those who are best acquainted with them."

Coming down to modern times, we find Tragus [Buck, in English] in 1552 describing and figuring very characteristically, referring also to such ancient authors as Theophrastus and Pliny, four pitch trees—two of them pines—*Pinus*, *Pinaster*, *Abies*, *and Larix*.

Dodoens in 1583 describes and figures:

Pinus sylvestris pinaster.
Pinus sylvestris altera.
Pinus maritima major.
Pinus maritima minor.

Caspar Bauhin, in 1623, published:

Pinus sativa.
Pinus sylvestris.

Arizonica (the last collected by Rothrock), and lastly, Gordon in his "Pinetum," 1875, published the true *tuberculata*.

PRINCIPAL AMERICAN PUBLICATIONS.

Space admits of but the bare mention of the principal publications of North American pines, some of them illustrated: Eaton's Manual, Elliott S. K., Michaux Flor. Am. Bor., Darby's Bot. S. States, Chapman Flor. S. States, Newberry's Pacific R. R. Reports, Michaux & Nuttall's N. A. Sylva (beautifully illustrated), Robinson's Trees of Mass., Curtiss' Resources of S. Forests, Torrey in Pacific R. R. Reports and Bot. Mex. Boundary, Lesquereaux Arkansas Flora, Gray's Manual, Wood's Class Book, Hoopes' Evergreens, Young's Bot. of Texas, Hall's Bot. of Texas, Vasey's Catalogue of Forest Trees, Rothrock's Whéeler's Explorations, Kellogg's Forest Trees of California, Bolander in Proc. Cal. Acad., Veitch's Manual of Cone-Bearers, Watson in King's Survey 40th Parallel, Engelmann's Revision of the Genus Pinus and his "Abietineæ" in Bot. Cal., Prof. Sargent's Forest Trees of North Am. in 10th U. S. Census, various publications of the Forestry Bureau, Department of Agriculture, and 1st Biennial Rep. Cal. State Board of Forestry.

Of these publications special mention should be made of Michaux & Nuttall's Sylvia, with illustrations, 1885, Hoope's Evergreens, Engelmann's "auf klarung," as the German might express it, of the great confusion previously existing in the literature of pines, by his scholarly and profound "Revision of the Genus *Pinus*," and his description of Tribe *Abietineæ*, in Bot. Cal., 2d Vol., both published in 1880; and Prof. Sargent's elaborate and exhaustive descriptions of the habitat qualities, uses, values, products, etc., of the forest trees, as cited.

NUMBER OF SPECIES OF PINES.

The Hebrews wrote of the "Pine," knowing but one tree of the name, since named *Pinus sativa* by Bauhin, and renamed *P. pinea* by Linnæus.

Theophrastus wrote of "Pine" and "Pinaster," the "wild pine" (pinaster meaning like a pine), now our *P. sylvestris*.

Pliny mentions these two trees and alludes to a third "along the shores of Italy," resembling it; (*P. maritima*, Lamark).

Tragus describes 2 species.

Dodoens describes 4 species.

Bauhin describes 10 species.

Tournefort describes 10 species.

Linnæus condensed the forms to 5 true pines (as now classified), while admitting several other genera as pines.

Gordon describes 85 species, and a great number of varieties under a host of provisional names, given by zealous collectors.

Dr. Engelmann, in Revision of the Genus Pinus, enumerates 76 species as the product of all the earth, putting 12 of the names in parentheses as synonyms, or marked varieties. Of these 34 species are within the United States and Territories, with 7 of his under synonyms. In Botany of California, Vol. II, he describes 14 species and 5 varieties—the latter being *albicaulis*, *aristata*, *Jeffreyi*, *scopulorum*, and *Murrayana*.

Sargent, in Forest Trees of the United States, describes 34 species, raising (by his direction having revised his classifications) 5 of Engelmann's varieties to the rank of species, to wit: *albicaulis*, *reflexa Jeffreyi*, *serotina*,

and *clausa*, and in Sargent's work one of Engelmann's new species (*P. Elliottii*) is reduced (by the doctor's direction) to a variety of *P. Cubensis*.

In this publication another of Engelmann's varieties (*aristata*) is taken away from *P. Balfouriana* and given full rank, making 23 species on the Pacific Slope, 18 in California, with 10 marked varieties.

DIAGNOSIS OF THE GENUS PINUS.

The genus *Pinus* belongs first of all to the great class of—

GYMNOSPERMÆ,

Plants with ovules orthotropous, naked upon the surface of a scale or bract within a more or less open perianth, fertilized by the direct contact of the pollen with the nucleus. Flowers monœcious or diœcious. Cotyledons usually more than 2 in a whorl.

Wood composed mainly of disk-bearing (pitted) tissue without proper vessels.

The class comprises:

Order Gnetaceæ—Joint-stems.

Order Taxaceæ—Yew trees.

Order Coniferæ—Cone-bearers.

Our genus PINUS belongs to the latter.

CONIFERÆ.

Resinous, mostly evergreen trees, with usually acerose or scale-like leaves, monœcious or rarely diæcious; male flowers reduced to the stamens only, indefinite in number, often numerous; the filaments upon a central axis with the anther cells (2 or more) adnate to the back of the connective or suspended from the under side of its scale-like or peltate summit; fertile aments consisting of few or many scales, becoming in fruit a dry cone, or fleshy and berry-like in Juniperus; ovules naked, 2 or more at or on the base of each scale, adnate or free, erect or inverted; seeds naked or winged, with chartaceous or crustaceous, or sometimes bony testa. Embryo straight, axile in fleshy, oily albumen. Cotyledons 2 to several in a whorl.

Trees or shrubs of cold or temperate latitudes principally comprising three TRIBES.

Cupressineæ—Cypresses.

Taxodineæ—Sequoias.

Abietineæ—Firs, Spruces, and Pines.

Our genus is in the last tribe:—

ABIETINEÆ.

Scales of the fertile ament numerous, spirally imbricated, carpellary, each in the axil of a thin bract, in fruit becoming a coriaceous or ligneus strobile or cone. Ovules 2, adnate to the inner face of each scale near the base, inverted. Seeds usually separating from the scale at maturity, and carrying away a conspicuous, scarious wing. Cotyledons 3 to 16. Anther cells 2, extrorse, parallel and contiguous upon the sides of the connective,

which is often surmounted by a scarious, dilated, inflexed tip or crest. Leaves scattered, in the genus *Pinus*, from linear to acerose. Leaf buds scaly.

Contains five Genera, the four first named maturing their cones in one year.

1. ABIES—the FIRS. Leaves sessile, leaving circular scars; cones erect, their scales deciduous from the axis. Seeds with resin vesicles.

2. PSEUDO-TSUGA—DOUGLAS SPRUCE. Leaves petioled, the scars transversely oval; cones pendulous, scales persistent. Seeds without resin vesicles.

3. TSUGA—HEMLOCK. Branchlets rough from the prominent, persistent leaf-bases, bracts of the cone smaller than the scales; cones pendulous. Leaves petioled, with a single dorsal resin duct. Seeds with resin vesicles.

4. PICEA—SPRUCES. Having also the above characters of *Tsuga*, except leaves sessile, keeled on both sides with 2 lateral resin ducts. Seeds without resin vesicles.

5. PINUS—PINES. Cones requiring 2 (in one European species 3) years to complete their growth, their bracts becoming corky and thickened; leaves (the conspicuous foliage) in fascicles of 2–5 (solitary in *P. monophylla*) from the axil of scarious bracts, their base surrounded by a sheath of scarious bud-scales (called the sheath) usually serrulate. Pollen 2-lobed. Resin ducts inconstant in number, usually numerous, variously situated.

ANALYSIS OF ORGANS.

LEAVES AND THEIR MODIFICATIONS.

(Always arranged in spirals, except the first.)

True Leaves.—1. Cotyledons (4–18).

2. Primary; always solitary, usually serrated. and in [illegible]

3. Secondary; always conspicuous, terminating an undeveloped branch and in bundles (one solitary, *i. e. Pinus monophyhlla)*, of from 2–5, and sheathed at base with bracts.

Duration.—Pine leaves are either soon deciduous, or falling in the autumn of the second year, or the third year, or they persist indefinitely four to many years.

Structure.—Leaves are composed of—

1. Epidermis, which is thin or thick.
2. Parenchyma (main tissue), meager or abundant.
3. Resin ducts, which are either peripheral, *i. e.*, near the epidermis; parenchymatous, *i. e.*, in the main tissue; or internal, near fibro-vascular bundles. (These latter are microscopic, but important characters, distinguishing the pine family into large sections.)
4. Fibro-vascular bundles (2), the woody, central portion, more or less united.
5. Strengthening cells, conspicuous, or rarely absent.

The leaves also are either sessile or peduncled, and either serrulate or entire; acute, obtuse, or denticulate; also, they bear longitudinal rows of white lines of stomata over either or both surfaces, or with none, or but few on the back in some species.

Bracts.—They are of five kinds and are either fringed or entire, often articulated and either deciduous or persistent:

1. Ordinary, found at base of leaves or along internodes.

2. Sheathing, few to many around leaf-bundles.
3. Bud-scales, few to many surrounding embryo leaves.
4. Involucral, few to many sub-tending male flowers.
5. Amentaceous, entire or dentate, corky and concealed at maturity by carpellary scales.

FLORAL ORGANS.—MONŒCIOUS.

Male.—Compound flowers arising annually from the base of the season's growth and composed of few or numerous short or elongated spikes:

1. Involucre, of few or many oval or dissimilar scales.
2. Stamineal column, ½ inch to 4 inches long.
3. Anthers, 2-celled, crowded, and composed of (*a*) connective, which is either rounded or crested; (*b*) pollen, bi-lobed, 0.045–0.25 lines in diameter.

Female, or Cone.—An ament becoming a cone, arising either sub-terminal, *i. e.*, near the leaf-bud; or lateral, *i. e.*, along the shaft of a growing shoot (important distinguishing characters), all requiring two years to mature them (one requiring three years), hence, seemingly becoming lateral the second season by the prolongation of the stem. Cones are either sessile or peduncled, and either solitary or opposite, or verticillate or clustered.

Dehiscence.—Cones are found either—

1. Remaining erect, or are declined during second season.
2. Falling at maturity entire, or leaving basal scales.
3. Persisting on the trees two to many years either—
   (*a*) Firmly closed, preserving the seed for years; or
   (*b*) Open more or less, shedding the seed at maturity.

Appearance.—Cones are either—

1. Globose, depressed, oval, ovate, or cylindrical.
2. Symmetrical, or more or less oblique or knobbed.
3. Colored differently at the two stages—yearlings and mature.
4. Various sizes according to species, conditions, etc.

Structure.—Cones are composed of—

1. Carpellary scales, few or very numerous; more or less flattened and imbricated; thin and leathery, or thick and corky, and composed of—
   (*a*) Claw, attaching to axis or placenta, and channeled above to hold the two seeds.
   (*b*) Blade, more or less compressed and striated.
   (*c*) Apophysis, the exposed upper part, usually thickened, and either rounded, pyramidal, or dimidiate; also either naked or umbonate or pustulate; the umbo either armed with weak, deciduous, or persistent prickles; or with strong spines or hooks. (The characters of the Apophysis are found to be of paramount importance in distinguishing groups.)
2. Bracts, concealed at base of scale, channeled beneath, to hold the two seeds.
3. Ovules (2), naked, *i. e.*, without either pistil or stigma (giving the name *Gymnospermæ* to the class.)

Phyllotaxy.—The arrangement of the carpellary scales is quite interesting, but of little diagnostic importance, since they differ in the same species—often in the same tree.

The arrangement is by series of spirals, two of which, inclining in opposite directions, right and left, are the most prominent. The most common numbers are 3 and 5, 5 and 8, 8 and 13, and 13 and 21.

Seeds.—The seeds of the pine are destitute of resin but abounding in oil;

their form is either globular, ovate, oblong, or obliquely triangular; in size they are 2–12 lines long. Their parts are:

(*a*) Envelope, a more or less hard case or shell (*testa*), and a close wrapping sheath (*endocarp*).

(*b*) Albumen, abounding in oil.

(*c*) Embryo, inverted and composed of—
Cotyledons, 5–18 and elongating.
Radicle, becoming a rootlet.

DR. ENGELMANN'S CLASSIFICATION OF THE SPECIES OF PINUS.

[From Botany of California.]

§ 1. Apophysis thin, with a terminal, unarmed umbo; anthers terminating in a knob, or a few teeth, or a short, incomplete crest; leaves in fives, with (in our species) peripheral resin ducts, their sheaths loose and deciduous; cones, sub-terminal.—*Strobus.*

* Wings longer than the seeds; leaving serrulate and (at least when young) denticulate at tip; female aments, long peduncled.

+ Strengthening cells few.

1 P. monticola.

+ + Strengthening cells abundant.

2 P. Lambertiana.

* * Wings much shorter than seeds; leaves mostly entire; not denticulate at tip.

3 P. flexilis (albicaulis) (reflexa).

§ II. Apophysis with a mucronate or (very rarely) blunt protuberance on the back; anthers terminating in a semiorbicular or almost orbicular crest, except in the first three species.—*Pinaster.*

* Resin ducts peripheral; leaves with entire margins and loose, deciduous sheaths.

+ Leaves 1-5; cones ovate, subglobose, with few very protuberant scales; seeds large, almost wingless.

4. P. monophylla.
5. P. Parryana.

+ + Leaves in fives; cones ovate to subcylindrical, with numerous scales; seeds small, winged.

6. P. Balfouriana, Var. *aristata.*

* * Resin ducts parenchymatous; leaves serrulate, with stomata on all sides; sheaths persistent.

+ Cones subterminal. ++ Leaves in fives.

7. P Torreyana.

++ ++ Leaves in threes.

8. P. ponderosa, Var. *Jeffreyi*, Var. *scopulorum.*

++ ++ ++ Leaves in pairs.

9. P. contorta, Var. *Murrayana.*

+ + Cones lateral. ++ Leaves in threes.

10. P. Sabiniana.
11. P. Coulteri.
12. P. insignis.
13. P. tuberculata.

++ ++ Leaves in pairs.

14. P. muricata.

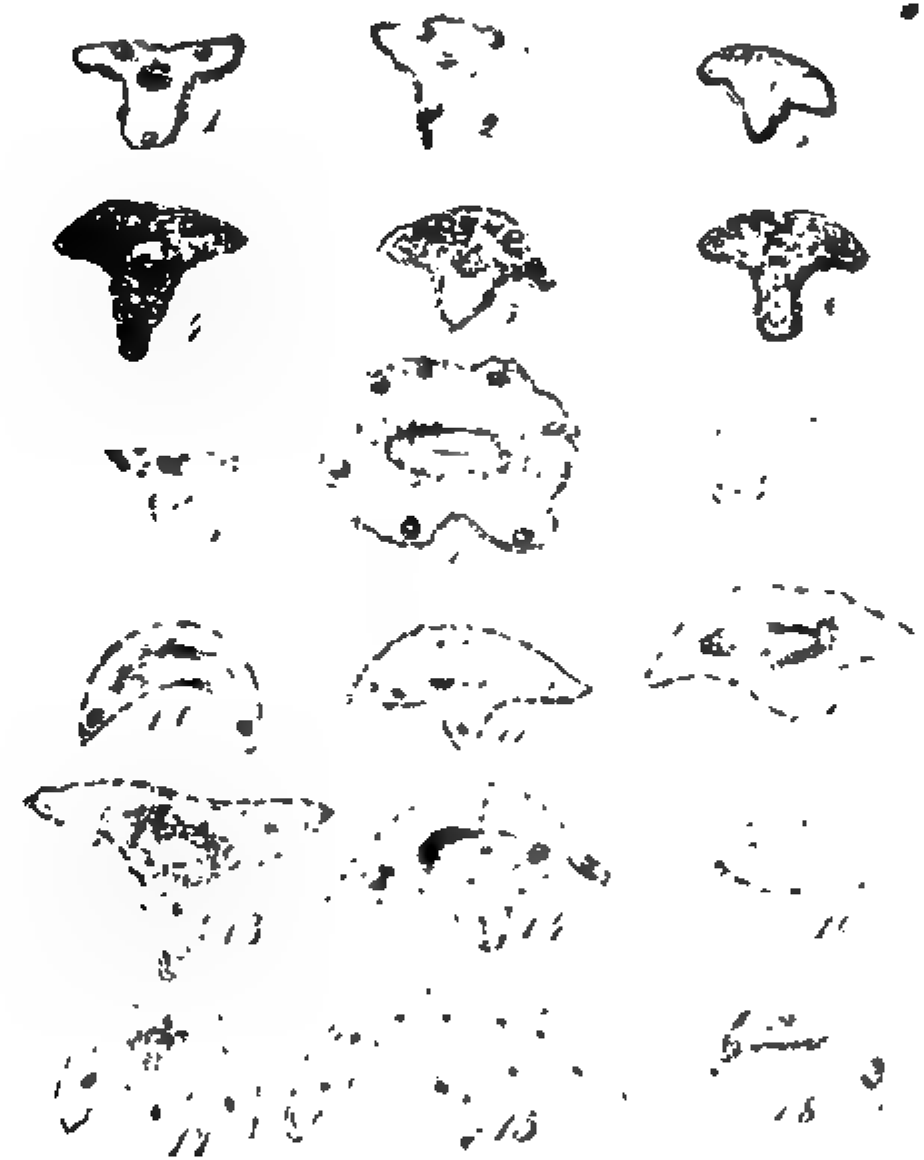
FRUIT, FLOWER, AND FOLIAGE CHARACTERS OF CALIFORNIA PINES—One-sixth natural size.
No. 1. Leaves, flowers, and seeds; 2. Pinus flexilis; 3. albicaulis; 4. Murrayana; 5. contorta; 6. Balfouriana; 7. aristata.

FRUIT, FLOWER, AND FOLIAGE CHARACTERS OF CALIFORNIA PINES—One-sixth natural size.
No. 1. Pinus insignis; 2. tuberculata, 3. muricata; 4. monophylla; 5. Parryana; 6. Coulteri; 7. Sabiniana.

Fruit Flower and Foliage Characters of California Pines.—One-sixth natural size. No. 1. Open Cones of *Pinus Lambertiana*; 2. unopened Cones, Foliage, &c. of *Pinus Lambertiana*; 3. *Monticola*; 4 *Jeffreyi*; 5. *ponderosa*.

Fruit, Flower, and Foliage Characters of California Pines—One-sixth natural size.
No. 1. Open cone of Pinus Coulteri; 2. Unopened cones of P. Coulteri; 3. Opened cones of P. Sabiniana; 4. Details of P. Torreyana.

Trunks of pine trees, showing character of bark.



Cross Sections of Pine Leaves—Magnified 11 diameters. The numbers correspond to those of the descriptive list.

Leaves, Seeds, Wings, and Male Flowers of the 18 California Species—One-third natural size. No. 1. Pinus monticola; 2. Lambertiana; 3. Pinus flexilis; 4. albicaulis; 5. Balfouriana; 6. aristata; 7. monophylla; 8. Parryana; 9. contorta; 10. Murrayana; 11. ponderosa; 12. Jeffreyi; 13. Torreyana; 14. Sabiniana; 15. Coulteri; 16. insignis; 17. tuberculata; 18. muricata.

REPORT

OF THE

Engineer of the State Board of Forestry.

REPORT OF ENGINEER.

LETTER OF SUBMITTAL.

To the California State Board of Forestry:

Gentlemen: On the first day of August, 1887, having been commissioned by your honorable Board to continue the work so ably and successfully commenced by Mr. Hubert Vischer, I assume the duties of Engineer of the State Board of Forestry. I was instructed to visit the timbered sections of the State, to prepare forest maps of the same, and to collect whatever data bore upon the subject of the protection and preservation of our forests. Acting upon these instructions, I have visited and located the forest growths of the following counties: Siskiyou, Modoc, Lassen, Shasta (east of the Sacramento River), Plumas, Sierra, Nevada, Placer, Tehama, Butte, El Dorado, Amador, Colusa, and Yolo. Forest maps have been prepared of all these counties except Colusa and Yolo, and are appended to this report. The chief object of the maps is to show the location and extent of the forests, and while it was attempted to give a correct idea of their situation, no account was taken of the innumerable bald hillsides, bare flats, and ridges, which occur throughout all of the forests, unless they were of large extent.

The boundary lines of forests are seldom located alike by two persons, their ideas of where a forest begins or ends being often very dissimilar, and thus apparent errors may have been made. Forest growths have been generally referred to by the names under which they are best known in their respective localities, and have been placed upon the maps in the same manner. A general description of the timber belts in each county is given, but as their locations are shown upon the maps, repetition was avoided as much as possible.

I have to acknowledge the courtesies shown to your Engineer by all of the citizens met with in the counties visited, likewise the information which they most willingly furnished. Especially am I indebted to the various County and United States Deputy Surveyors, who were always both able and willing to give much important and extensive information.

The Board is also greatly indebted to William Hammond Hall, State Engineer, for the use in advance of publication, of the valuable State maps which he had prepared, and to R. P. Hammond, Jr., United States Surveyor-General, who kindly furnished room in his office for draughting purposes.

Respectfully submitted.

H. S. DAVIDSON.

San Francisco, November 1, 1888.

THE SIERRA FORESTS,

AS PRODUCERS OF LUMBER—THE PREDOMINANT VALUE OF DIFFERENT BELTS.

Of all questions of vital importance to the welfare of California, the forestry problem has received the least attention. Accustomed to draw upon our forest resources with little or no thought for the future, acting upon the prevalent impression that our forests have to serve no other purpose but to provide lumber and fuel for our immediate wants, we have treated them as though they were wildflower gardens—picking choice blossoms here and there, and leaving the rest to shift for themselves, regardless of the result. Trees desired for some particular purpose have been felled, while their less valuable brethren have been left to wait patiently for the time when scarcity of timber shall make the neglected and despised scrubs of to-day of marketable value. But of late years the people of California have awakened to the fact that our forests are not only valuable for the lumber and fuel with which they supply us, but also as regulators of hydrologic and climatic conditions (which have been referred to in another chapter), and have at last made a move toward their protection.

As furnishers of raw material, our forests play an important part in the future prosperity of the State.

How to preserve the wood necessary for our buildings, fences, railways, and mines, as well as for manufacturing and domestic purposes, is a question which daily becomes of greater importance, and one which demands immediate attention.

It is true that the forest wealth of California is enormous, but there exists only a supply commensurate to the prospective wants of her people.

While the forest area of California will never increase, the population is rapidly doing so.

Timber is a natural product whose pecuniary value is dependent upon its economic application. In the form of lumber it becomes the product of labor, and the cost of production determines its value, whereas the wealth of the timber contained in the forests which cover our mountain slopes is regulated by the accessibility of its position, the cost of transporting it to a market, etc.

With the increase of our population, new districts are settled and improved, lands formerly considered of no real value are placed under cultivation, and the line separating the tilled from the untilled region is speedily advancing over the less elevated portion of the latter. Inseparable from a productive country is the need of cheap transportation; and new wagon roads are built, old ones repaired, and soon a railroad is constructed to meet the growing demand.

Thus, much timber formerly of little intrinsic value, on account of the absence of cheap transportation, is made available, and its pecuniary worth being increased an hundredfold, it is felled and sent to a market.

It must be remembered that we are drawing on the capital stock of our forests without the least attempt towards replantation, and as the natural reproduction is very small, owing to the want of proper protection, the question resolves itself into the simple problem: "Given the present amount of standing timber and the actual consumption (including destruction and waste), to determine how long it will last."

Vast numbers of people are almost daily arriving from the more populous Eastern States, looking for land upon which to settle and make themselves homes. One of the first requirements made by a land seeker is, the inexpensive access to a sufficiency of wood, and proportionally as these new settlers take up and improve land, our timber area is reduced.

An increase of population must necessarily be accompanied by an increased demand for lumber, but with an increase in the demand, there follows a decrease in the supply, and finally the demand will exceed the supply, and we shall be obliged to procure our lumber elsewhere.

Not only will our forests be drawn upon to supply the home demand, but other States and Territories will look to us for a portion of their lumber.

The extensive country east of the Rocky Mountains and extending to the Mississippi River, has for years drawn upon the forests of Michigan, Wisconsin, and Minnesota for its lumber, and when these at one time magnificent forests are exhausted, will turn to the Pacific Coast for the greater part of its timber.

As the lumber supply east of us gives out, the eastern lumbermen push west to seek new fields, and already a great deal of capital has been invested in California timber lands.*

During the past two years, speculation in timber lands in the Sierra Nevada Mountains has been rife. On school lands alone timber representing millions of feet of lumber has either been bought and paid for or has been filed and refiled upon in such a manner as to keep control of it.

Hon. Theo. Reichert, State Surveyor-General, has kindly furnished the following report as to the number of acres of timbered land in some of the northern counties that have been paid for by purchasers from the State from January 1, 1887, to October 15, 1888:

Siskiyou County	13,060 acres.
Lassen County	800 acres.
Sierra County	1,580 acres.
Placer County	320 acres.
El Dorado County	1,000 acres.
Shasta County	11,600 acres.
Tehama County	1,760 acres.
Plumas County	2,900 acres.
Butte County	720 acres.
Amador County	640 acres.
	34,320 acres.

That is, fifty-three and six tenths square miles of forest.

In each township there are two school sections, Sections 16 and 36, leaving thirty-four sections of Government land, and since the cash-entry law has come into effect, purchasers can obtain possession of Government timber land at the same price ($2 50 per acre) and with as little trouble as of school land. It is true that one person can buy but one hundred

* A correspondent to the San Francisco "Daily Morning Call," under date of August, 1887, writes as follows: "I have just returned from a trip through the northern counties, and I have never seen a finer country than Siskiyou County affords. The climate and scenery are something wonderful. I have spent some two months in Siskiyou, having been sent there as an expert for Sugar Pine timber land, and I must say the timber in Squaw and Elk Valleys excels that of Michigan and Montana. I have been all over the State and Territory named to purchase timber land, but found the Sugar Pine of which I was in search very scarce there. It will not be more than a year before we eastern millmen will come to California for our Sugar Pine, as this timber is hard to find in the East, and it is valuable for ship building. There will arrive in California soon an eastern syndicate of wealthy millmen, and this may have the effect of sending the timber lands of Siskiyou up in the market. My purchases have been one thousand two hundred and forty acres, at $1 20 an acre, and I am satisfied that in a year's time similar land will bring $4 to $5 per acre. I expect to return next year and erect my sawmill, and in the meantime will have my machinery made."

and sixty acres of Government land, whereas he can obtain as high as six hundred and forty acres of school land; but he is obliged to choose his school land from two designated sections in each township, while with the Government land he has thirty-four sections in each township to select one hundred and sixty acres from, and by getting others to purchase also can frequently secure a large continuous body of timber. Thus the inducements for purchasing Government timber lands are as great, if not greater, than those offered by State lands, and in the past twenty-two months (January 1, 1887) there have been purchases from the Government in the following counties: Siskiyou, Modoc, Lassen, Shasta, Plumas, Butte, Tehama, Yuba, Sutter, Placer. Nevada, Sierra, Amador, El Dorado, and Calaveras. The estimate of the number of acres is based on the following entries at local land offices, each entry presumably covering one hundred and sixty acres:

Shasta Land Office	296 entries, or 47,360 acres.
Susanville Land Office	84 entries, or 13,440 acres.
Marysville Land Office	327 entries, or 52,320 acres.
Sacramento Land Office	116 entries, or 18,560 acres.

We would then have in the counties enumerated two hundred and five and three fourths square miles of Government timbered land, and probably the best and most heavily timbered, that has become private property in the past two years, making a total (including school lands) of two hundred and fifty-nine square miles, or one hundred and sixty-five thousand seven hundred and sixty acres, representing, at a very low estimate, one billion five hundred million feet of lumber that has been sold since January 1, 1887. As regards filing on timber land in this State, it is safe to say that it is done for speculation only. No man can clear or make a living on one hundred and sixty acres of heavily timbered land, nor, for that matter, on six hundred and forty acres; consequently, to a poor man, the land is of no value unless he can sell it, and this he does as quickly as possible, generally to millmen or capitalists. Thus the poor man defeats the effects of the very law which was made for his benefit. The history of the California redwood cases in Humboldt County,* is to-day being repeated in our sugar pine forests.

Why both the Government and the State still continue to sell all timbered lands at $2 50 per acre, without regard to their present or prospective worth, is a problem most difficult to solve. If all timbered lands were graded, and prices in keeping with their present values set upon them, it

* Referring to office report of 1886 and 1887 regarding certain entries of land in the Humboldt (California) District, under the Act of June 3, 1878, alleged to have been made in the interest of the Humboldt Redwood Company, hearings having been held in regard to forty-seven of these entries, and by office decisions of March 29 and April 14, 1888, the same were held for cancellation. The testimony at these hearings showed that the entries were made in the interest of a syndicate organized for the purpose of securing title to a large tract of land very valuable for the redwood timber thereon. The entries were shown to have been made by reckless and wholesale perjury and subornation of perjury. Regular agents were employed, who were authorized to offer men $50 each to make entries for such land and to execute a deed of the same, the entry men rarely knowing to whom they transferred the land.

The parties who now claim the land made no attempt to contradict the testimony offered by the Government relative to the fraudulent character of the entries, or to show that the entries were made in good faith.

The records of Humboldt show that the land embraced in about three hundred and sixty entries under the Act of June 3, 1878, amounting to about fifty-seven thousand acres, has been conveyed to the Trustees of the Humboldt Redwood Company, composed of Scotch capitalists, and other parties, citizens of the United States, associated with them. The timber alone on the land was estimated, by one of their associates in the venture, who is a timber expert of great experience, to be worth $11,000,000.

would be much more in accordance with justice, both to the purchaser and to the seller, and would, besides, put a check on indiscriminate speculation.

The establishment of some system to regulate the sale of timbered lands and to protect our mountain forests, is of so great importance to the future welfare of the State, that it cannot, with safety, be much longer delayed. That the State must have administrative control over her forests is a foregone conclusion, and until this is accomplished, little can be done towards protecting the forests.

The dire results following the indiscriminate felling of forests in the Eastern States should serve as a lesson by which the people of California should profit, and guard their own forests. But this end can only be obtained by the diffusion of knowledge on the subject among the settlers and citizens of the State, many of whom, from long familiarity with forest impositions and outrages, have grown callous on the subject.

The adoption of a plan somewhat similar to that now in vogue in some of the provinces of Canada* would undoubtedly prove beneficial, not only to the forests, but to the treasury of the State.

Lands chiefly valuable for the standing timber upon them could be leased for a period of years, the time in each case being sufficient to allow the lumbermen to get out all of the large-sized trees, and then reverting to the State again, could be given a rest of say twenty or thirty years, to allow the young trees to grow to a marketable size and a new growth of seedlings to come up. This plan would not only prevent speculators from gaining the control and possession of timber lands, but would present to bona fide lumbermen opportunities of securing choice timber without being compelled to pay for land which, in most cases, is of no intrinsic value to them. Timber lands would thus become a source of continued revenue to the State, and would more than pay for their protection.

THE PREDOMINANT VALUE OF THE FORESTS OF THE SIERRA WATERSHED.

Nature has been most bountiful to California in many ways, but in none more so than in her wise provisions for providing the chief agricultural portion of the State with an ample water supply. The Sierra Nevada range of mountains in California are about four hundred and fifty miles long and sixty-five miles wide. Lying in the extreme eastern portion of the State, they form an immense watershed, dependent on which is nearly our entire river system for its source of supply. Nearly the whole width of the range is taken up by its western slope, which descends gradually from its extreme heights of fourteen thousand four hundred and fifty feet and fourteen thousand eight hundred and eighty feet (Mount Shasta near its northern, and Mount Whitney near its southern extremity) to an elevation of four hundred feet above the level of the sea. At present we have to deal only with the most northern half of the range, and hereafter, in alluding to the Sierras, it will be understood that only that portion north of the Mokelumne River is meant.

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*Mr. J. K. Ward, in a very interesting article on "Lumbering in Canada," says: "The different provinces of the dominion make the regulations and conditions on which the timber lands can be worked. In Ontario and Quebec vacant territory is usually sold by auction (in blocks varying in size from one to fifty square miles) at prices ranging from $2 to $500 per mile. In addition to this the lessee pays $2 annual ground rent per mile, and also a stumpage on all timber cut on the territory occupied.

"Each province has its tariff of prices. In Ontario red and white pine are subject to 1¼ cents per cubic foot. Other woods vary in price: pine, basswood, and cottonwood saw-logs, 15 cents per two hundred feet, board measurement; walnut, oak, and maple logs, 25 cents per two hundred feet; hemlock, spruce, and other woods, 10 cents per two hundred feet; railway timber, knees, etc., 15 per cent, ad valorem."

These mountains are generally covered with an abundant forest growth, and contain the most valuable timber lands outside of the redwood belt. The west slope of the Sierras may, for convenience of distinction, be divided into three belts. The upper, or mountainous belt, including all the territory above an imaginary zone, at an elevation of four thousand feet; a middle belt, between four thousand and two thousand feet elevation; a lower belt, extending from the bottom of the middle belt to the valley land below.

THE LOWER BELT.

We will first take up the lower belt, which includes nearly all of the territory spoken of as the foothills of the Sierras, and which differs entirely from the other two belts in its topography, climate, and natural resources. Commencing near the central part of Shasta County, this belt continues nearly in a straight line through Tehama, Butte, Yuba, Nevada, Placer, El Dorado, and Amador Counties, embracing at least six thousand five hundred square miles, or four million one hundred and sixty thousand acres of land. It is more or less covered with a timber growth consisting of oak, pine, buckeye, manzanita, and chemisal. The oaks are represented by Quercus lobata (California white oak), Quercus Douglasii (Blue Douglas oak), Quercus chrysolepis (Golden Leaf Cañon live oak), and Quercus Wislizeni (highland live oak). Of the pines, the Pinus Sabiniana (Digger, or nut pine) is, with an occasional exception, the sole representative. This tree grows to a height of forty or fifty feet and is from two to three feet in diameter, and is generally found in scattered groups of six or eight, among scrubby white oak, or thickets of manzanita and brush. In fact, throughout the foothill region the trees grow at a considerable distance apart, and, except from a distance, bear but little resemblance to a forest.

This lower or foothill belt is fast becoming famous as a fruit and vine region, and it will not be many years before the greater portion of it will be covered with orchards and vineyards, and what timber growth it now possesses will be cut for fuel and fencing. Olives also thrive among these foothills, and, with the orange, are already pressing hard upon those raised in the southern counties for the precedence.

There is no doubt but that this region is much more valuable for agricultural purposes than for the timber on it, and that it would be the height of folly to attempt to preserve this timber growth to the detriment of immensely valuable interests. This, then, is clearly a case in which the forest growths are of no economic value to the State, and we may look forward without alarm to the time when they will entirely disappear from this region.

THE MIDDLE BELT.

This belt includes all of the territory between the imaginary zones of two thousand and four thousand feet elevation, and on the west slope of the Sierra varies in width from ten to forty miles, with a general average breadth of fifteen miles.

Ascending past the lower margin of this belt, the yellow pine first greets you, making its appearance among the oaks and Digger pines, which are common also to this belt. It is a worthy forerunner of the forest monarchs to be met with higher up the range. Appearing to be able to endure all climates, and to subsist on most soils, it has the most extensive range of all conifers in the Sierras, extending from the lower boundary of the middle belt to the upper limit of the timber line. The yellow pine is nearly as tall as the Sugar pine, and ranks next to it as a lumber tree. Throughout

the Sierra forests it is the most common species, and is easily distinguished by its bark, which is arranged in massive plates four or five feet long and a foot and a half in width.

The Jeffreyi variety of this pine (called black pine) reaches its best state of development in the northern part of the range, especially in the vicinity of Mount Shasta. It is this variety also which is found in a dwarfed form upon stone-ridden ridges and upon rocky and volcanic soils.

The knobby cone pine (Pinus tuberculata) is also to be found in this belt, especially in the vicinity of Mount Shasta, where it reaches its greatest height, often one hundred feet. Generally along the west slope of the Sierra it is thirty or forty feet high, and grows in the midst of chaparral, or on sunny hill and cañon sides, and although not extensively represented, grows quite densely wherever it is found. In this belt the Douglas spruce (Abies Douglasii), commonly known as red or yellow fir, attains its finest development, often reaching a height of two hundred feet, and a diameter of six or seven feet. It is a long lived and hardy tree, growing in most soils, and is scattered throughout the pine belt, below an elevation of eight thousand five hundred feet. It is the most valuable of the spruce family, and ranks next to the yellow pine as a lumber tree.

The Incense Cedar (Libocedrus decurrens) makes its first appearance in this belt, nearly always associated with the yellow and sugar pine, but never forming extensive groves. Under favorable conditions it often ascends to an altitude of seven thousand feet, but it flourishes and grows vigorously between three thousand and six thousand feet, seemingly impartial to the nature of the soil. The largest trees are about one hundred and fifty feet high and seven feet in diameter.

The California nutmeg tree (Torreya Californica) is found along the streams and in the gulches throughout the middle belt, attaining its fullest development at an elevation of about four thousand feet. It is a small evergreen tree, generally about thirty feet high, rarely growing in clusters, and never forming extensive groves, but rather appearing here and there among other growths, and is not largely represented. The wood is very firm and elastic, and when dry is sweet scented. Its timber is very durable, but the scarcity of the tree prevents it from being of much economic value.

Half way up this belt (three thousand feet) the sugar pine (Pinus Lambertiana) is first seen—the monarch of the Sierra, and the most valuable pine in California.

Towering above its neighbors, the sugar pine has a majestic bearing entirely its own, and even in its associates seems to have chosen the more worthy dwellers of the forest, as the yellow pine, Douglas spruce, and white silver fir (at higher altitudes), are its constant companions.

Extending from an elevation of three thousand feet to one of nearly eight thousand feet, it attains its finest development at five thousand feet, full grown trees being over two hundred feet in height, and from six to eight feet in diameter. One specimen seen near Hams Station, in Amador County, was thirteen feet in diameter, and nearly three hundred feet high. Although generally associated with the growths previously mentioned, when it represents the smaller percentage of the trees, it is quite often found growing in belts where it forms the back of the forest, especially on deep soiled mountain sides and favorably located ridges.

The sugar pine has a smooth, round, and column-like trunk, usually without limbs for two thirds of its height, when its long and heavily fringed arms stretch out, sometimes being forty feet in length.

It derives its name from the fact, that where wounds are made, by ax, fire, or other means, that a sugar exudes in the form of crisp, white crystals, which are very sweet to the taste, with scarcely any pine flavor.

The sugar pine is the most valuable lumber tree of the Sierras, and will be felled wherever found, and as it is but slightly represented among the young growth of our coniferous forests, and is of very slow growth, it is simply a matter of time, under present conditions, when the sugar pine will have disappeared entirely. This belt is destined to become more or less stripped of its forest growth, the upper portion for lumbering purposes, and the lower for fuel, fencing, and lumber.

Many of the smaller creeks serving as feeders to larger streams, either have their source in this belt, or are dependent upon the watersheds of it for their supply, and thus while the preservation of a part of the forests of this belt is not of as much importance as the protection of those around the head-waters of rivers in the upper belt, it is still of sufficient moment to justify legislation in its interest.

THE UPPER BELT.

The upper or mountainous belt includes all the territory above an elevation of four thousand feet, and contains the finest coniferous forests in the world. This belt also forms the great watershed of the Sierras, dependent upon which are our principal rivers for their constant supply.

The lower margin of the belt differs but little from the upper half of the middle belt, the Digger pine being the only conifer which does not cross the boundary line.

From an elevation of four thousand five hundred feet to one of eight thousand five hundred feet, extending along the entire length of the Sierras (above the Mokelumne River), lies the grand coniferous forest of California. When viewed from a distance, it presents the appearance of a gloomy and dense mass of timber, but upon entering its territory the openness of the growth and the absence of underbrush is a most striking feature, appearing as though these grand forest monarchs needed an abundance of breathing space, and could not tolerate minor growths even around their feet. The lower portion of this forest is composed chiefly of pine, both yellow and sugar, then as the middle elevation is approached the firs are about equally represented, and become more numerous as you ascend, the sugar pine gradually disappearing. The beauty of these magnificent forests of pine and fir has been so often described that further mention would be superfluous. Next to the pines, the firs (including all lumber called fir) are the most valuable, as well as beautiful, trees in the Sierras. The white silver fir (Abies [Picea] concolor) grows between the elevations of three thousand and eight thousand feet, but seems to prefer an altitude of four thousand to five thousand feet. Standing over two hundred feet in height, with a diameter of from three to eight feet, its symmetrical white trunk free of limbs for fifty to one hundred feet, and crowned with a graceful top of living green, it is a most stately and beautiful tree. Its wood ranks high as valuable lumber, and is largely used for the inside finish of houses, for butter tubs and packing cases, etc. Owing to its great strength and power of resistance under pressure, it is well adapted to the construction of bridges, use in mines, and wherever great stiffness and strength is desired. As it does not rot when partly buried in earth, holds spikes well, and outlasts any other wood, it makes the best of railroad ties. It is well distributed throughout the Sierras, where it is generally called simply white fir.

The grand silver fir (Abies [Picea] grandis), also called white fir, is very closely related to the Abies concolor, and in size and grandeur resembles it. It extends over the entire length of the Sierras at an elevation of from five thousand to nine thousand feet, and is more noteworthy on account of its lofty and stately appearance than for the quality of its lumber. The wood is soft and white, and most excellent for an inside finish, but when placed in contact with the ground rots very quickly. Unlike the Abies concolor, it has a very noticeable odor, which unfits it for many of the uses of the former. As a lumber tree it is but little thought of by lumbermen, and consequently is seldom felled.

The noble silver fir (Abies [Picea] nobilis), generally called spruce and red fir, is, like all the firs, a grand and stately tree, attaining a height of nearly three hundred feet, and a diameter from six to ten feet. It extends over the entire length of the Sierras at an elevation of from five thousand to nine thousand feet, and in the vicinity of Mount Shasta forms large forests. The immense trunks are of a dark, cinnamon-red color, and the fan-like green branches are silver-lined, growing very densely and with a wide spread, nearly to the top. Closely associated with this tree, but more commonly represented, is the variety Magnifica, the magnificent red silver fir (known as red fir). It has the same range as the Abies nobilis, which it resembles in appearance, and even exceeds slightly in size. Its foliage is somewhat coarser than that of the nobilis, and is of a silvery blue rather than a silvery green tint. Both varieties flourish in deep snow, over which their dense foliage acts as a protector from the sun's warm rays. Their wood is used largely for fuel, but with the exception of coarse lumber, made chiefly from the Magnifica variety, they are never used by lumbermen. When felled and left to lie upon the ground, they rot very rapidly.

The Pacific silver spruce (Abies Williamsonii), commonly called spruce, is a strikingly beautiful tree, and the most silvery of all the conifers. It is found on the summits of the Sierras, at an elevation of from seven thousand to ten thousand feet, a fine sturdy tree from one hundred to two hundred feet in height, and from five to nine feet in diameter. The trunk resembles that of the sugar pine, and is often clear of branches for eighty or one hundred feet. It is generally associated with the firs, and like them, is a snow-loving tree. Where accessible it is cut considerably for lumber.

The tamarack pine (Pinus contorta), generally called tamarack, and var. Murrayana (called pitch pine) extend over nearly the whole range of the Sierras, and forms the bulk of the forest above the fir belt. Growing at lower altitudes on damp flats, it climbs the moist slopes of mountain ranges, grows along the banks of elevated creeks, and in the interior regions of the Sierras grows abundantly on dry soils, generally replacing other species destroyed by fire. A small tree of twenty to forty feet in height at lower elevations, it reaches in the higher Sierras a height of over one hundred feet. The bark is rich in a turpentine moisture, and consequently catches fire readily, vast numbers of this tree being thus destroyed. The wood is light and strong, but not durable, and is used chiefly for fuel.

The Mountain pine (Pinus monticola) makes its first appearance on the upper margin of the fir belt as a scattered growth, but gradually increasing in numbers until, at ten thousand feet, it is the prevailing tree. It is a hardy and long lived tree, gaining in size and strength just where other trees weaken and disappear, and at its best development is nearly one hundred feet high.

The dwarf pine (Pinus albicaulis) is first met at the upper margin of the fir belt. It is a small tree from fifteen to thirty feet high, and grows

up the slopes of high peaks in a kind of straggling manner, until at an elevation of eleven thousand feet it degenerates into a low bush. It forms the edge of the timber line.

The Juniperus Occidentalis (juniper or red cedar) grows from an elevation of seven thousand feet to one of ten thousand. Apparently seeking the baldest and most rocky mountain slopes, it is the most weather beaten appearing tree in the Sierras. Frequently over seven feet in diameter, and not more than twenty feet in height, it looks more like a dismantled stump than a tree. The wood is soft, close-grained, and light, and is valuable for a great many uses.

Intermixed with the larger growth of the upper belt are numerous smaller species, the most important being madrona, laurel, aspen, birch, and mountain mahogany. These trees are used only for fuel, but the madrona and laurel are worthy of a better use, and although their merits are not appreciated now, time will discover their value.

That the lower portion of this upper forest belt must finally be denuded of its timber, is not to be doubted. The forests of pine will be the first to go, and as the demand for lumber increases, the firs will probably follow. The topography of a country is a most important factor in regulating the climate, flow of streams, and other conditions.

It is generally known that mountain forests exercise a great influence over the flow of streams by preventing the sudden evaporation of snow, etc.,* and that most disastrous results follow their removal—such as mountain torrents, periodic floods and droughts, and many other disasters.† The great watershed of the Sierras supplies and regulates the flow of nearly all the rivers in the State, and it is upon the rivers that the greater part of the agricultural land is dependent for irrigation. The people of California appreciate the worth of water, and, to a certain extent, attempt to protect the rivers. A law was passed prohibiting the filling up of certain rivers with debris, thus putting a stop to hydraulic mining. If a minor evil is so readily understood and corrected, why should we shut our eyes to a threatening disaster, compared with which, the first sinks into insignificance? Strip these watersheds of their forest covering, and the prosperity of California is at an end; so to prevent such a happening, it is of the utmost importance that steps should at once be taken to protect our forests. It is a very simple matter to cut down trees, and it can be done in a short while, but it takes years to grow them, and to replace a forest which is cut off in ten years would require at least two hundred years of protecting care.

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* Ebermayer has, as the result of trustworthy meteorological observations on forestry, arrived at the following conclusion: "If, from the soil of an open space, one hundred parts of water evaporate, then from the soil of a forest free from underwood thirty-eight parts would evaporate, and from a soil covered with underwood only fifteen parts would evaporate." (Ander's House Plants and Sanitary Agents.)

† Dr. H. Rogers, of Mauritius, in a report issued by him in 1871, on "The Effects of the Cutting Down of Forests on the Climate and Health of Mauritius," says: "Still in 1854 the island was resorted to by invalids from India as the *pearl* of the Indian Ocean, it being then one mass of verdure. When the forests were cleared to gain space for sugar cultivation, the rainfall diminished even there; the rivers dwindled down to muddy streams; the water became stagnant in cracks, crevices, and natural hollows, while the equable temperature of the island entirely changed; even drought was experienced in the midst of the ocean, and thunder showers were rarely any longer witnessed. The lagoons, marshes, and swamps along the seaboard, were no longer filled with water, but gave off noxious gases; while the river waters became impure from various refuse. After a violent inundation in February, 1865, followed by a period of complete dryness, fever of a low type set in, against which the remedies employed in ordinary febrile cases proved utterly valueless. From the waterless sides of the lagoons pestilential malaria arose, exposed to which the laborers fell on the field, and in some instances died within a few hours afterwards."

Authorities upon the subject place the proportion of forest covered land necessary to the well being of a country, at one fifth of its entire area. While it is not proposed to attempt to reserve any such proportion in this State, there is most pressing need to protect the forests covering the watersheds at heads of streams. If this was done, the most of the danger would be checked, and at small price.

FOREST FIRES.

Here we have to deal with a destructive agent whose devastating course it seems impossible to check or prevent. Consuming each year thousands of acres of fine timber, endangering and often destroying the property of settlers, menacing the homes of all those who live in timbered regions, the forest fire, year after year, continues its ruinous course, unrestrained by the law, and unheeded by the majority of the people.

The law in California pertaining to forest fires reads as follows:

SECTION 384 (Penal Code). Every person who willfully and negligently sets on fire, or causes or procures to be set on fire, any woods, prairies, grasses, or grain, on any lands in this State, is guilty of a misdemeanor, and is punishable by fine not exceeding five hundred dollars, or imprisonment not exceeding six months, or by both such fine and imprisonment.

The State Board of Forestry has caused to be posted throughout the timbered regions of the State, notices setting forth the above law, and inviting citizens to report any violation of it, offering a reward ranging from twenty-five to two hundred dollars for the first information in any instance on which an action at law can be based, but with very indifferent success. It is true that these notices have served as a warning, and have been most beneficial in informing the settlers of timbered districts, and especially sheepherders, of the existence of such a law, thereby making them more careful in building fires in the woods; but they have not succeeded in inducing any one to come forward to present the evidence requisite to convict the starter of a forest fire. It is hardly reasonable to expect that any settler will inform against his neighbor, and the sheepherder is generally so far removed from any habitation that his crime rarely has a witness. In regions where the timbered lands are more or less owned by corporations or private individuals, great care and precaution is taken to prevent and check fires, and the owners of such lands vigorously condemn the Government for not exercising sufficient supervision to prevent forest fires. But when devastating fires sweep over wooded lands not suitable or available for cultivation, and belonging to the Government, the average citizen or settler in the neighborhood remarks, "What a shame to destroy such fine trees—the Government ought to put a stop to these forest fires," never reflecting for a moment that it is the selfish indifference and want of action of himself and his similar feeling neighbor that renders the Government powerless to check this great evil.

Along the Yellowstone River, in Montana, I have seen settlers ride for a mile or more after careless campers who had left their camp fires burning, and compel them to return and extinguish the smoldering fire. This was done to prevent the bunchgrass from taking fire and spreading for miles over the valley or prairie, endangering the settlers' houses and crops. It is true that the motive was oftentimes one of self interest, but so strongly was every one imbued with the spirit of preventing prairie fires, that those who had nothing to lose showed as much zeal in the cause as the man whose home and all was at stake. If the citizens of California living in wooded

districts would show a little of this feeling and interest, large and disastrous fires would frequently be prevented or checked before doing serious damage. There is no reason why camp fires should not be extinguished when the camp is abandoned, and if campers knew that all citizens took a personal interest in having this attended to, and that they (the campers) were liable to fine or imprisonment for their neglect—for leaving a fire burning in a thickly wooded country should be made a criminal offense—they would be extremely careful to assure themselves that the fire had been put out before being abandoned.

The most disastrous fires, from a forest point of view, are unquestionably those started by the sheepherders who drive their flocks into the higher regions of the Sierras to feed during the summer months. These men, ignorant and shiftless, as a rule, do not comprehend the magnitude of the injury inflicted upon forests by fire, and looking upon our vast mountain ranges as "no man's land," think that it does not matter in the least how they treat them. A great many of these herders, especially those who return year after year to the same grazing regions, set fire to the undergrowth upon leaving in the fall, so as to improve the herbage of the following spring and summer. Removed as they are from all human habitation, they are free to commit whatever depredations they please without the least fear of detection, for when a forest fire occurs in the region which they are occupying with their sheep, although the presumptive evidence may be strong as to the origin of the fire, still there were no witnesses to the deed, and no one can be held responsible. If our mountain ranges are to be continually used as a free pasturage for sheep and other animals, it would appear that the only method that can be adopted to check forest fires is to divide the heavily timbered mountain ranges into districts, each of which shall be supervised by a forester, or guard, whose duty it shall be to acquaint himself with the location and the name of the owner of each band of sheep, cattle, or horses that may enter his district, and then in case of any herder setting fire to the woods, his employer should be held responsible for all damage done. This plan would, of course, necessitate the control of the forests being in the hands of the State, and until this is accomplished, there seems to be but very little hope of preventing fires in our mountain forests.

An idea very prevalent with the majority of the people, is that forest fires only destroy the underbrush and young trees, and that the larger and full grown trees are uninjured, or at most only scarred. This belief is very erroneous, as I have seen, notably in Shasta County, trees two hundred feet in height, blazing clear to the top, and dozens of them burning at the same time, and any one traveling through the Sierras cannot fail to notice the large number of charred and half burned stumps of large trees, often twenty feet high, whose tops have fallen when the trunks were half consumed, and were themselves wholly or partially consumed upon the ground.*

* The "Popular Science Monthly" of September, 1886, published an extract from a private letter of Dr. Heinrich Maye. He says: "The disappointment in regard to forests in Japan which I experienced was keen. The Japanese have sent out many students to Europe to study forestry, and have, therefore, the reputation of possessing forests; but nothing of that; the mountains are bare, and the forests burned down, just as they are in the eastern part of the Rocky Mountains. Americans might take a fearful warning in regard to the future prospect of their great West; only the landscape will be still more desolate there, because the land is so divided into small holdings that no forest will be raised.

Japan is the land of inundations, and the effects of forests upon moisture are here most strikingly illustrated. Every thunder shower sends its whole quantity of water without delay to the rivers and the sea, and within a few hours a mountain valley has seen a dry channel, a raging torrent, and a little brook occupying the same bed; thousands of acres of

These larger fires which consume matured trees, confine themselves entirely to the forests of pine and fir, the trees of which being rich in pitch, catch fire very easily and give out an intense heat. These fires often assume such proportions that the atmosphere at a distance of fifty miles from the scene of the conflagration will assume that hazy appearance caused by dense smoke. In the Sierras, the largest and most destructive fires occur almost invariably in those regions used for pasture. Fires occur more or less frequently near habitations, caused by the carelessness of settlers in clearing land and allowing their brush fires to get beyond their control and escape into the surrounding forest; but they form but a small percentage of the total number. Hunters, and especially Indian hunters, are blamed for many fires, but they are probably not guilty of more than 20 per cent of the charges made against them, and each year sees even this small percentage lessened. The Indians were undoubtedly at one time the chief cause of forest fires; setting fire to immense bodies of woods in order to clear out the underbrush, that they might more easily hunt and capture game; but they have ceased such practices long since, and have become so reduced in numbers, that but small bands, or more often but three or four, hunt in company, and they practice stalking almost entirely. In those districts in which Indians were accustomed to set fires, the discontinuance of that custom has resulted most beneficially to the young forest growths.*

Teamsters freighting over mountain roads are occasionally the cause of fires, either by neglecting to extinguish a camp fire before leaving a camping place, or by setting fire to a windfall which has toppled across the road, from which the underbrush ignites and starts a forest fire.

Our conifers suffer most from fires, and especially the two-leaved pine, or tamarack pine (Pinus contorta), which, above the fir belt, forms the bulk of our alpine forests. The thin bark of this tree is so streaked with resin that even the green trees catch fire, and during high winds the flames speedily advance, leaping from tree to tree, and destroying entire forests. Slow and smoldering fires that creep along the ground, feeding on the litter of burs and needles, on arriving at the foot of a tree, ignite the resinous bark, and a flame of fire shoots up to the top of the tree of sufficient heat to kill it, and the bark gradually drops off, and then the branches fall, leaving only the trunk. Miles of territory in the upper Sierras may be seen apparently staked out with bleached spars.

While the injuries done our forests by fires are to be deplored, there appears to be no hope of checking them under the present condition of affairs, and until a general system of protection is devised and put into operation, they will be compelled to suffer.

The following is but one of the many notices of forest fires which are continually appearing in the newspapers throughout the State, and will serve as a sample for the rest:

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good land along these numerous mountain streams cannot be cultivated, because the forests are lacking, which would retain the moisture and allow it only gradually to seek the river and ocean. We cannot realize enough the consequences of forest destruction. But even Arbor-Days are only a small remedy; the State alone can own large tracts of successfully cultivated forest land."

*I was informed by Mr. J. M. Davidson, United States Deputy Mineral Surveyor, and an old resident of Scott Valley, in Siskiyou County, that fifteen years ago the entire west side of Scott Valley was almost devoid of young forest growths, owing to the fires set out each year by the Indians. But this practice having been discontinued, and fires occurring only once in six or seven years, the young growth has been afforded an opportunity of maturing, and now forms such a dense jungle that the old traveled trails are impassable.

BURNING TIMBER.

Large Forest Fires Raging in the Santa Cruz Mountains.

SAN JOSÉ, October 23, 1888.

Mountain fires north of Santa Cruz are doing much damage in the woods, and at times are threatening houses. Much timber has been destroyed, and the flames are spreading so rapidly and covering so much territory that considerable alarm is felt. The station house at Wrights and the bridge of the Southern Pacific Railroad have just had a narrow escape. ["San Francisco Daily Examiner," October 24, 1888.]

ILLEGAL TIMBER CUTTING.

Illegal timber cutting has been carried on quite extensively in former years by millmen and others, especially in remote and thinly settled regions, but of late years the shake-makers are the principal depredators.

Millmen were accustomed to cut beyond the boundaries of their claims with but little fear of detection, and with the belief that if they were found out and prosecuted, that they could settle at a very low rate of stumpage. But recent investigations made in this State by Government officials have taught them that such proceedings are attended with considerable risk, and have tended to make them keep within their own confines.*

ANNUAL REPORT OF THE COMMISSIONER OF THE GENERAL LAND OFFICE FOR 1888.

The shake-makers can be found throughout the Sierras, generally a shiftless set who cannot bear the restraint and superintendence of manual labor in populated districts, preferring rather to lead a free and careless life in the mountain forests, working only when they feel so inclined or are pressed to it by want of food. Scenting out a Sugar pine as easily as a terrier does a rat, they visit every accessible district in the Sierras, and a pile of shakes is often the only visible sign that any human being resides in these mountain solitudes. They are often called, perhaps aptly, forest pirates; and as, from force of circumstances, they are compelled to prey entirely upon Government and State lands, they destroy considerable of our public sugar pine timber, especially as they fell about three times the number of trees that they make use of, often cutting down five or six before finding one suited to their purpose. Although this practice of making shakes is generally condemned, and is certainly illegal as carried on, it has become so established a custom that no one thinks of interfering, and as to lodging a complaint against a shake-maker, public opinion is against it; for, like the Irish, the American people hate an informer.

Early settlers have always, and most justly, helped themselves to whatever timber offered to build their cabins and fences and for fuel. In thinly settled districts, timber upon Government land has been invariably looked upon as public property to be had for the cutting, and as long as it was put to private and local uses, no thought was given to it, but as soon as it became a source of profit to special individuals, and was gone into on a large scale, the criminality of the practice was made apparent.

It is not the injury done by a single shake-maker that gives rise to complaint, but the general destruction caused by the hundreds who are engaged in this business. Happily it is a practice that a careful supervision over

* Among the important cases in which suits have been or soon will be recommenced on the agents' reports, are the following: In California two against lumber firms for $37,000 and $732,000, respectively. The suit against the Sierra Lumber Company to recover $2,000,000 for the lumber unlawfully cut from public land is still pending.

our forests will abolish, as the shakes will always serve as proof of the crime.

RAINFALL AS AFFECTED BY FORESTS.

The subject of the influence of forests upon meteorological conditions, although of great practical significance, is one upon which there is such a vast diversity of opinion, the conclusions arrived at being to a great extent inferential, that it is most difficult to arrive at the truth.

Forests are certainly instrumental in producing light rains and dews, but it is hardly reasonable to suppose that they affect the rainfall, unless they are situated upon high mountains; for, according to well known meteorological principles, rain is formed at a distance of from one to two miles above the surface of the earth.

Any one interested in the subject may find the appended precipitation table of interest.* It was compiled from data contained in State Engineer Hall's report for 1886, "Physical Data and Statistics of California."

PRECIPITATION TABLE—SHOWING THE AVERAGE OF RAINFALL AND MELTED SNOW.

Locality.	Elevation.	Years Observed.	Average of Total Precipitation.
Marysville, Yuba County	67	14	16.56
Chico, Butte County	193	14	20.32
Tehama, Tehama County	220	14	13.85
Rocklin, Placer County	249	14	19.13
Ione, Amador County	287	6	19.65
Red Bluff, Tehama County	307	13	25.27
Redding, Shasta County	565	10	36.79
Smartsville, Yuba County	800	9	33.12
Delta, Shasta County	1,138	2	63.50
Auburn, Placer County	1,363	14	32.74
Placerville, El Dorado County	1,857	9	45.62
Colfax, Placer County	2,421	14	44.81
Georgetown, El Dorado County	2,500	12	59.18
Nevada City, Nevada County	2,500	19	56.96
Berryvale, Siskiyou County	3,462	2	28.76
Alta, Placer County	3,612	14	43.64
Fort Bidwell, Modoc County	4,647	18	20.07
Mumford Hill, Plumas County	4,900	6	65.24
Emigrant Gap, Placer County	5,230	14	51.73
Bowman Dam, Nevada County	5,400	13	73.33
Boca, Nevada County	5,531	13	17.35
Truckee, Nevada County	5,819	14	29.53
Cisco, Placer County	5,939	14	57.41
Summit, Placer County	7,017	14	47.93

PLANTING FOREST TREES FOR PROFIT.

The cultivation of forest trees in California is as yet in its infancy, and it will take many years of patient endeavor to teach the people of the State that forest trees may be grown with profit. What trees have been planted have been almost exclusively for shade and ornament, and, while not abundant in any one locality, would, in the aggregate, form a very respectable forest.

Profits from tree planting are too far in the future to please the average farmer, who wishes to reap the benefits of an investment as quickly as possible, and in many cases is dependent upon an early return for his livelihood. Whereas our native forest trees are of slow growth, taking from sixty

* By referring to the forest maps, the location of each station as regards forest surroundings can be ascertained.

to one hundred and fifty years to reach maturity, a species of foreign growth has, of late years, been introduced into our State, which promises to solve affirmatively the question, "can forest trees be grown with profit," and that species is the eucalyptus, or, as it is often called, the Australian gum.

This tree seems to possess all of the requirements in which our native species are lacking, and, while not as valuable a lumber tree as our conifers, its special virtues commend it as the most profitable tree to plant.

Its chief recommendations for this purpose are its exceeding rapidity of growth, its remarkable adaptability to various soils and climates, the excellence of its wood, both for timber and fuel, together with the various other economic uses to which it is put. Most productive of forest trees, it requires absolutely no attention save that of planting out, and does not wear out the patience of generations in attaining an available growth of timber.

In Australia this family is found growing under all conditions of soil and climate, from the hot and arid desert to the tops of mountains at an altitude of five thousand feet, and there is no apparent reason why the barren area of this State should not be made productive and beautiful with forests of this tree.

Among the multifarious growths of the eucalyptus, many different varieties of wood are found, supplying lumber for all conceivable purposes. Although it is the most important and widely distributed forest tree in Australia, it was not until it had been transplanted in California that one of its most useful and valuable properties became known, and then it was due to accident. A gentleman (Mr. Downie) used in the steam boilers of his mill, water that had been strained through leaves of the blue gum tree, and he subsequently noticed a remarkable falling off of the troublesome scale that had incrusted the interior of the boilers. Attributing this curious fact to the right cause, he formed a company for the extensive preparation of an extract from the leaves, which was placed upon the market as the Downie Boiler Incrustation Preventive and Remover, and so great was the success which it met with among those using steam boilers, and so quickly did its fame spread, that now it is in use not only throughout California, and upon steam vessels which enter the harbor of San Francisco, but throughout the United States and Europe, and by the navies of the world.

Large quantities of eucalyptus oil, composed largely of an essential oil called Eucalyptol, is produced as an incidental to the preparation of the boiler fluid, and is used in surgery as an antiseptic, and for various other purposes. The wood which has been accumulated by this boiler fluid company in the vicinity of Oakland, by the felling and topping of the blue gum tree, was placed upon the market, and, although at first it brought but one half the price paid for pine wood, it soon came into great demand, especially for steam-making purposes, and now commands a price equal to, and frequently in excess of, that of any other wood fuel.

A forest of Eucalyptus globulus, which was set out near Los Angeles several years since, gave the following results:

Cost of trees at time of planting	$7 50 per acre.
Cost of setting out	5 00 per acre.
Subsequent cultivation	5 00 per acre.
Annual rental of land	3 00 per acre.
Or, for seven years	21 00 per acre.
Making the total cost, at the end of seven years	38 50 per acre.

Now, as there were ninety-seven acres of trees planted, the total cost at the expiration of seven years was $3,734 50. The value of the trees

was as follows: Amount of wood on the land, thirty-five cords per acre, or $66 50 per acre for seven years, which, at $3 per cord, was worth $105; or $10,185 for the entire ninety-seven acres. This gives a net profit of $6,450 for ninety-seven acres in seven years, which is an annual profit of $9 50 per acre. In many localities, the cost of putting out the trees and the rental of the land would be much less, and oftentimes the growth would be much greater. It may be readily seen, from these figures, how profitable an investment the setting out of the eucalyptus can be made. Wood may be cut from these trees in six years after planting, but if large timber is desired, of course a longer period (say from fifteen to twenty years) is required. Further than this, the trees never die, and it is next to impossible to kill them. They may be cut off so as to leave only a bare stump, and immediately they begin to put forth leaves and branches, and at the end of five years another crop of wood can be cut. So tenacious of life are these trees, that they may be cut level with the ground, and even this heroic treatment will not destroy them.

Besides being the most profitable tree to plant as a pecuniary investment, the Eucalyptus makes a most desirable and effective wind-break, and will, it is claimed, arrest malaria if planted in swampy districts,* while in arid regions it serves as a producer of heavy dews.

We have a large treeless area in California, which will not produce crops without irrigation, and which is looked upon as waste and valueless land, that might most beneficially and profitably be planted with the eucalyptus. This tree will become in time better known, and its value will be more appreciated than at present, and before a great many years has passed, it will be generally distributed throughout the State.

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*Mr. A. W. Bennett, writing in "Nature," says: "The effect of the planting of forests in increasing the rainfall is often erroneously reputed to be due to the 'attractive force of the trees' on the moisture in the air, similar to that exerted by a range of mountains; but this supposition he regards as untenable. The mode in which trees mainly act is," he says, "by their roots arresting the rainfall that would otherwise escape by the natural drainage of the country; the combined forces of capillarity, osmose, and transpiration then cause the ascent through the tissues of the tree of the water thus arrested, and the larger portion is eventually given off into the air through the stromata of the leaves. In this way a forest tree will in a very short time give off into the air its own weight of water, which is again deposited as rain or dew. It is quite possible, however, that the effect of the planting of trees may be *apparently* the reverse of this in swampy regions without natural drainage. The water then accumulates in the soil; and if the country is bare of timber trees and the sun powerful, a rapid decomposition takes place of the herbaceous vegetation, with consequent emanation of malarial vapors. If trees be planted, the effect is to supply natural drainage; the accumulation of water in the soil, and the consequent noxious effluvia, will be diminished, and finally prevented, and the atmosphere rendered, if not drier, at least more wholesome."

DESCRIPTION OF COUNTIES.

SISKIYOU, MODOC, LASSEN, PLUMAS, SHASTA, BUTTE, TEHAMA, PLACER, SIERRA, NEVADA, AMADOR, EL DORADO.

SISKIYOU COUNTY.

Lying immediately north of Trinity and Shasta Counties and extending to the Oregon line, and reaching from Modoc County on the east to Del Norte and Humboldt Counties on the west, Siskiyou has the distinction of being the most elevated county in the State. Covering an area of six thousand square miles, principally consisting of high mountains and broad plateaus, and far removed from railroad communication, the chief industries have been mining and stock-raising, but with the advent of the California and Oregon Railroad, which has lately been completed, and which runs through the central part of the county from north to south in close proximity to the magnificent pine forests in the southeastern part of the county, lumbering will soon become a leading industry.

The Sierra and Coast Range of mountains meet in this county at Mount Shasta, whose snow-capped peak serves as a landmark for Northern California.

There are two distinct watersheds in this county, formed by the Coast Range in the northwestern part and draining into the Klamath River, and by Mount Shasta and spurs of the Sierras in the southern part draining into the Sacramento River, which rises near the southwest base of Mount Shasta.

The Coast Range, locally known as the Salmon and Siskiyou Mountains, is situated in the western and northwestern part of the county.

The Salmon Mountains are from six thousand to ten thousand feet above the level of the sea, their tops being covered with perpetual snow, and are the most desolate, wind-swept, and storm-ridden mountains in the State. Accessible only by trails, they are never visited except by hardy prospectors, or by herders seeking grazing ground on their eastern and more protected slopes. West of these mountains, and south of Independence Creek, is a wild rugged region with but little vegetation. On the table lands, at an elevation of about eight thousand feet, there is a small scattered growth of stunted yellow and sugar pines, and red fir; while on the summits of the range, white and silver fir of small size, and mountain larch, can be seen. Chestnut, ash, and alder grow along the streams, and a few black and white oaks are scattered over the broken hillsides. North of Independence Creek considerable madrona grows on the low hills.

East of Salmon Mountain range and extending north over the Marble Mountain Range and Scott Bar Mountain, is a good belt of timber, consisting of red fir, yellow and sugar pine of good size in the southern part of the belt, and adding white and silver fir, and cedar on Scott Mountain and Marble Mountain Range. On the west side of Scott Valley there is some first class timber, chiefly red fir, but in consequence of the mountainous

character of the country, and the difficulty in getting it out, very little has been cut. Black and white oak are among the other growths on the east slope of the range, and alder, ash, and chestnut grow along the rivers.

In Scott River Valley small cottonwoods seem to flourish along the streams, and at Fort Jones the black locusts, planted on either side of the principal street, thrive as well as those growing in more southern towns.

On Scott Bar Mountain the timber reaches a large size, especially the yellow pine, which is frequently two hundred feet high and nine feet in diameter. The cedar also is well represented here.

These ranges of mountains act as a wind-break for the country east of them, and as a watershed for Scott River, and owing to their inaccessible character, will probably never be stripped of their timber.

Deadwood Mountain Range and Humbug Mountain are fairly well timbered with yellow pine and red fir, extending up to the Klamath River, the best timber being in the vicinity of Humbug Creek.

Along the Klamath River, west of the California and Oregon Railroad, the black oak prevails, with a good sized madrona growth near the banks.

The country north of the river is taken up by the Siskiyou Mountains, and is better timbered than that immediately south of the river.

Good yellow pine, red fir, cedar, and sugar pine form a scattered growth over these mountains, and are thickly intermixed with black and some white oak.

The black oak here reaches its finest development, and on the mountain benches, at an elevation of two thousand five hundred feet above the river, from Beaver Creek down to Happy Camp, may be seen black oaks five and six feet in diameter, with trunks as straight as a sugar pine, and thirty-five feet to a branch.

On the summit of this range, especially on a high peak locally called Siskiyou Mountain, silver fir of large size grows abundantly. Along the streams there is madrona, ash, alder, and maple.

None of this timber has been disturbed, or is it likely to be, as the mountainous and rugged character of the country unfits it for habitation, and the difficulties in the way of shipping the timber are too great to be profitably overcome.

East of the California and Oregon Railroad there is but little timber black oak along the Klamath, and it is of much smaller size than that lower down the river.

At the point where the Klamath River enters California from Oregon, there is a belt of timber about twelve miles in width, which varying in density, character of timber growth, and width, extends in an almost southerly direction to the Snow Mountain Range, where it meets the northern extremity of the sugar pine belt.

As far south as Goose Nest Mountain (or crater), it consists of very good sized yellow pine, red fir, cedar, and some sugar pine of a fairly thick growth on the average, being quite dense in places.

Southeast of Goose Nest the timber is more sparse, nor is it, as a rule, as large as that last spoken of. Yellow pine, hemlock, cedar, and tamarack form the timber growths, except on the higher elevations, where Silver Fir of a moderate size grows in considerable quantities.

About one mile south of Edgewood begins the great sugar pine belt of Siskiyou. It runs in a general southeasterly direction through Strawberry Valley, and then easterly, along the south base of Mount Shasta, through the McCloud River Valley and to the Fall River Valley. This belt, which consists almost entirely of yellow pine, sugar pine, red fir, and cedar, derives its name from the large percentage of sugar pine which it contains,

and is probably the most valuable sugar pine belt in the State. Made accessible, in the past two years, by the California and Oregon Railroad, it has nearly all been purchased from the Government and the State by speculators and millmen, and already several large sawmills have been erected near the line of the railroad.

MODOC COUNTY.

Modoc County occupies the northeastern corner of the State, is rectangular in shape, and covers an area of four thousand three hundred square miles. The Warren Range of mountains, a spur of the Sierra, runs north and south through the county, at an average distance of fifteen miles from its eastern boundary. These mountains are from six thousand to ten thousand feet above the level of the sea, and are covered with a diversified growth of juniper, yellow and pitch pine, red fir, and mountain mahogany.

This range of mountains has almost its entire width on its western slope, its eastern slope being so precipitous that in many places it presents the appearance of a perpendicular wall. From the southern extremity of the county for forty miles north the timber growth is not well developed, and is rather scattering, tending frequently to grow in widely separated clusters or clumps, is not fit for saw timber, and is used only for fuel and fencing. But above the headwaters of Davis Creek the trees become larger and more numerous, and in the vicinity of Fandango Valley there is enough good saw timber to supply the local need for years to come.

This western slope of the Warner Range is drained by the Pitt River and its tributaries. The Pitt River rises in the northeastern part of the county, near the southern extremity of Goose Lake, and flowing southwesterly passes through a low portion of the Sierra, and forms the principal tributary of the Sacramento River. This river may be said to drain all of the watersheds in Modoc County, except the eastern slope and the northern part of the Warner Range, and the lava bed region in the northern part of the county, all of which is drained by Goose Lake.

West of Goose Lake there is a light growth of yellow pine, red fir, and cedar, forming small groves in the midst of the junipers, which constitute the prevailing growth. This timber is useful for fencing and firewood only.

In the southwestern part of the county, surrounding Big Valley, and extending over the mountainous region northwest of it, is a valuable growth of timber covering about six hundred square miles. It consists principally of yellow and pitch pine, cedar, and red fir, of good size and density, and when a railroad is built through this section, will be valuable for the lumber it will produce.

The best timbered region is immediately northeast of Adin, being the northern extremity of the belt which enters this county from Lassen County. Two sawmills have been cutting lumber here for a number of years, but as only a sufficient quantity to supply the local needs has been felled, the loss is hardly noticeable.

Modoc County is so removed from railroads that the transportation of her lumber to a market has been impossible; but when a railroad does pass through Big Valley and on up to Oregon, as it must some day, lumbering will become a leading industry.

LASSEN COUNTY.

Lassen County lies directly south of Modoc County, and extends from Shasta County on the west to the State of Nevada on the east, covering an

area of four thousand nine hundred square miles. While the main body of Lassen County is but sixty miles in length from north to south, it has a peculiar neck or strip of country extending southward on the eastern border of Plumas County, which gives Lassen an extreme eastern boundary of one hundred miles bordering on the State of Nevada.

Ranging in altitude from three thousand nine hundred and fifty feet at Honey Lake, to nine thousand five hundred and fifty-three feet near its western boundary line, and being made up of mountain ranges, isolated peaks, irregular hills, sagebrush plains, and cultivated valleys, this county presents a very diversified landscape.

The western portion of the county, which is also the timbered portion, is of a lava formation, and is a part of the great lava bed region, which extends from Modoc and Siskiyou Counties down through Lassen, Shasta, and Plumas into Tehama County. Although this lava formation as a general rule is not visible upon the surface of the ground, very little of this western portion of the county is cultivated except in the northwestern part, where the southern portion of Big Valley affords about ninety thousand acres of agricultural land.

This western portion of the county is well timbered, and has, as yet, been very little cut over, and what timber has been cut has been entirely for local uses, the want of cheap transportation preventing it being sent out of the county. Lying upon the east slope of the Sierra Nevada Mountains, the yellow pine naturally predominates among its forest growths, and represents about 60 per cent of all the timber in the county. Red Fir and pitch pine rank next to yellow pine in abundance, and cedar is well distributed throughout the region. These trees are of good average size—from three to ten feet in diameter—and are well distributed over this region, in some townships averaging from fifteen thousand to twenty thousand feet, board measure, to the acre. Sugar Pine, although not so generally distributed as the trees spoken of, is well represented, and reaches a fine state of development. South and southwest of Eagle Lake there is a fine belt of sugar pine, as yet untouched, and in the southwestern part of the county there is a great quantity of sugar pine, which, owing to the difficulty of transportation, has never been cut. In the vicinity of Harkness Peak, and for ten miles east of it, there is a fine growth of white fir, and in the southwestern part of the county, south of township 33 north, is a heavy growth of yellow pine, red fir, spruce, sugar pine, larch, and tamarack, with some willow and aspen around the lakes and along the creeks.

Above township 33 north the timber is of an open growth, and consists of large sized yellow and pitch pine, red fir, and cedar, to which is added juniper, white and black oak as it approaches Pitt River, and is generally distributed in belts over the uplands and ridges, following the contour of the hills. The undergrowth is usually manzanita, with some wild plum. The timber belt extends eastward to Susanville and Eagle Lake, and consists of a more or less heavy growth, at no time sparse, of yellow pine, red fir, cedar, sugar pine, and pitch pine. Along the edges of the belt juniper and mountain mahogany replace the larger growths.

Towards the north the belt reaches to Big Valley, where it narrows and extends around the east side of the valley into Modoc County.

Madeline Plains, an extended, level tract of land in the northern part of the county, having an altitude of over five thousand feet above the sea level, are covered by a dense growth of sagebrush. Extending around three sides of these plains is an irregular range of low mountains or hills, covered with a growth of juniper and mountain mahogany, which is used for fencing and fuel.

The timber in this county has escaped the fearful ravages of fire which have visited the forests on the western slope of the Sierras, but still has suffered to a noticeable extent. The causes of fire have been chiefly carelessness and indifference on the part of those living in the woods, whether sheepherders, hunters, or others.

Nearly the entire timber belt is used as a summer range for sheep, which are driven up over the mountains from Tehama, Butte, and the more southern counties.

There are only two sawmills in the county and they cut only sufficient lumber for local uses, but with the completion of the narrow gauge railroad which is now being built from Reno, Nevada, northward through the central part of the county, lumber will probably be sent to Nevada.

The fine timber in the southwestern part of the county will certainly be turned into lumber before many years have passed and shipped to a market. The greater part of the sugar pine timber has been owned for years by lumber companies or by private individuals, and as soon as the supply of the more accessible regions is exhausted, this section will also be stripped.

Unless the forests are destroyed by some agent at present unknown, Lassen County will never suffer from want of wood and lumber, and will also be able to supply her neighbors with a large amount of building material.

PLUMAS COUNTY.

Plumas County is bounded on the north by Lassen County; on the east by Lassen County and the State of Nevada; on the south by Sierra County, and on the west by Butte and Tehama Counties.

It covers an area of two thousand six hundred and fifty-six square miles, the greater portion of which is between three thousand and five thousand feet above the level of the sea.

Lying in the midst of the Sierras, its scenery is necessarily wild and picturesque, and as the climate is delightfully temperate during the summer months, it is much resorted to by those seeking both rest and recreation.

This county is well watered by innumerable small streams, and the watershed on the west slope of the Sierras is drained by the larger branches of the Feather River and their tributaries.

Several small valleys in the northern part of the county, and Sierra Valley in the southeast corner, constitute about all of the tillable land in Plumas, its chief resource being mining. With the exception of these small valleys, the entire county is covered with a heavy forest growth, which, owing to the lack of cheap transportation, has been but scarcely touched. Whatever timber has been cut has been almost entirely for local uses, and will not average much more than fifteen million feet a year.

The principal forest growths are yellow pine, red fir, pitch pine, sugar pine, cedar, black and white oak, all of which grow to large size, and in places very densely. As fine specimens of yellow and sugar pine, and red fir, can be seen in this county as in any portion of the State, and it is only owing to the inaccessibility of their positions that they have not long since been made into lumber.

The heaviest and thickest growths are generally found on the slopes of the Sierras, but many of the plateaus are covered with magnificent timber, notably the country around Prattville and the Big Meadows.

A considerable amount of territory in Plumas is so high and mountainous that it is not likely ever to be stripped of its timber, but as the supply

elsewhere decreases the greater part of the forests in the county will be felled for lumber.

Fire destroys a great quantity of valuable timber each year; and, owing probably to the apparently inexhaustible supply which is seen on every hand, no steps are taken to check or prevent it.

SHASTA COUNTY.

(East of the Sacramento River.)

That portion of Shasta County east of the Sacramento River is bounded on the north by Siskiyou and Modoc Counties, on the east by Lassen, and on the south by Tehama County. It covers an area of about two thousand eight hundred square miles, the greater portion of which lies in the Sierra. South of Smithson, the country where not cultivated is covered with a scattered growth of oak and Digger pine, with considerable manzanita and chaparral, and along the east side of the Sacramento River a straggling growth of knob-cone pine. This latter pine grows all along the east side of the Sacramento River, nearly as far north as Mount Shasta. Above Smithson, the timber on the east side of the river consists principally of pine and oak, with some red fir, being a scattered growth at first, and increasing in size and density as you go up the river, although hardly reaching a size to fit it for saw timber. The trees grow rather thickly for two thirds of the way up the mountain slope, the summit of which is from two to four miles from the river, and then becomes sparser, and on the east side of the summit are not so dense.

Four prominent peaks mark the Sierra in the eastern part of the county, the higher peak, Lassen, being timbered for little more than one half of the way up, and the others having bold and rugged slopes. The entire eastern part of Shasta County above Smithson may be said to be timbered, numerous little flats and valleys being excepted.

In the northern part the sugar pine belt of Siskiyou County extends quite a distance into Shasta County, and in fact the sugar pine is very well represented throughout the northern and eastern portions of Shasta County.

The principal forest growths are yellow and sugar pine, red and white fir, cedar, spruce, and oak. Heavy timber generally grows on the slopes and table lands on either side of the larger creeks, such as Hat Creek, Soda Creek, Squaw Creek, and Hatchet Creek, but is generally too inaccessible to get to a market.

Near Shingletown is a fine belt of sugar pine, rivaling that of Strawberry Valley in size and density. As the name implies, Shingletown is the home of the shake-makers, and here they are probably more numerous than in any other part of the Sierras.

The Sierra watersheds in this county are important factors in supplying the Sacramento River, as they are drained not only by that river, but by its two most important tributaries, the Pitt and McCloud Rivers. The latter river flows through a wild and rugged region, little visited except by hunters, and abounding in game, especially deer and bear. This region is well adapted for a State park, and, as it is of little economic value to either the citizens of the State or new settlers, it should be set aside for this purpose. Sawmills have been recently erected near the line of railroad in the northern part of the county, and are daily sawing thousands of feet of lumber, which, with that sawed in the eastern part of the county, makes the annual

cut in the neighborhood of twenty million feet. Forest fires have raged fiercely in this county, and have done much damage.

BUTTE COUNTY.

Butte County extends from Tehama County on the north to Sutter and Yuba Counties on the south, and from Plumas County on the east to the Sacramento River on the west.

It covers an area of one thousand seven hundred and sixty square miles, of which six hundred square miles are covered by the Sacramento Valley, the remainder being foothills of the Sierras.

The greater portion of this Sierra watershed is drained by the Feather River and its tributaries, while the Sacramento River and Butte Creek receive the drainage from the west half of the county.

Only the east half of the county, that portion lying in the Sierra foothills, is timbered, the west half being an extended plain, used for agricultural purposes.

The timber on the Sierra foothills is divided into three well defined belts or zones:

The First Belt.—From the base of the foothills to an elevation of two thousand feet above the level of the sea, the growth consists chiefly of white oak, with some black oak near the upper edge of the belt, and Digger pine, which now is much more dense than in former years, as the Indians no longer set out fires, and this pine being a rapid grower, it very soon reproduces itself. This timber is used only for fuel and fencing, and with the settling of this region, which is destined to become the finest fruit and vine district in the county, the timber will gradually disappear.

The Second Belt.—The belt from an altitude of two thousand feet to one of five thousand feet embraces all of the best timber in the county, consisting of yellow and sugar pine, red and white fir, cedar, black oak, madrona, dogwood, nutmeg pine (at an elevation of four thousand feet), and sweet birch (an excellent feed for cattle). Some tamarack grows on low and wet ground, and alder, yew, and quaking asp are found along the streams.

The Third Belt.—This belt extends from an altitude of five thousand feet to one of about seven thousand feet, and is but poorly timbered. The timber becomes scrubby as it approaches the summit of the mountain range, and degenerates to occasional groups of trees, chiefly silver fir. The greater part of this belt consists of bald hills, covered with chaparral, with here and there a few yellow pines. The timber in this county is distributed so diversely that a description is best given by townships.

Tps. 26 N., Rs. 4 and 5 E., are well timbered with yellow pine, red and white fir, Digger pine, sugar pine, cedar, and black oak. The southwestern portion of T. 6 N., R. 4 E., was at one time covered with a fine growth of sugar pine, but it has been mostly cut off. The Abeitine Medical Company's timber lands are located in these townships.

T. 25 N., R. 5 E., is but sparsely timbered with yellow pine, red fir, white fir, cedar, and black oak.

T. 25 N., R. 4 E., is covered with a good growth of yellow pine, red and white fir, cedar, and black oak. There has been fine sugar pine in the extreme northwest corner, but it is mostly cut down.

Tps. 24 N., Rs. 2 and 3 E., and T. 25 N., R. 3 E., have been heavily timbered with yellow pine, red fir, white fir, black oak, sugar pine, and cedar, but they have all been cut over by lumbermen, and the best of the remain-

ing timber is now found on the tops of ridges. There is a considerable growth of madrona, dogwood, and manzanita in these townships.

T. 25 N., R. 5 E., and T. 24 N., R. 5 E., are sparsely timbered townships, the growths being similar to those of preceding townships.

T. 24 N., R. 4 E., is very sparsely timbered east of the West Branch of the Feather River, the growth being chiefly chaparral, but west of the river there is a good growth of yellow pine, sugar pine (some has been cut off), red fir, black oak, and white fir.

T. 23 N., R. 5 E., is a well timbered township, especially on the west side of the North Fork of Feather River. There is a large quantity of sugar pine of good size, and very fine black oak, which thins out and becomes scattering towards the northern part of the township. There is also a good quality of yellow pine, red fir, cedar, and pitch pine.

T. 23 N., R. 4 E., is sparsely timbered with yellow pine, red fir, black oak, cedar, and pitch pine.

T. 23 N., R. 3 E. The edge of the timber belt extends from the southwest corner of Section 7, on a line through Helltown, in this township. There is some sugar pine in the northeastern part of the township, but not much, and the timber, which consists chiefly of black oak and yellow pine, grows scrubby towards the southern part of the township. Considerable white oak in cañons.

T. 22 N., R. 6 E.—The greater part of this township is well timbered, the exception being east of the wagon road running to the Buckeye House. There is a great deal of fine sugar pine, also yellow pine, red fir, black oak, and cedar. The Merrimac Mill is located in this township.

T. 22 N., R. 5 E.—The eastern half of this township, with the exception of the three lowest sections, is well timbered, principally with yellow pine, red fir, and black oak. The timber on the western half is scattering, generally following the ridges.

T. 22 N., R. 4 E.—The timber in this township consists of an average growth of yellow pine, red and white fir, black oak, and madrona. Somewhat scattering.

T. 22 N., R. 3 E.—Only the northeast quarter of this township lies in the timber belt, and the growth is scrubby, consisting of black oak, yellow pine, and red fir. Outside of the timber belt and following the ridges is a fair growth of black oak and Digger pine, with some white oak in the cañons.

T. 21 N., R. 7 E.—The middle belt of this township from north to south is the best timbered, the rest being fairly well timbered, except along the western boundary, where the timber is very poor. It consists of yellow pine, red fir, black oak, cedar, and some sugar pine.

T. 21 N., R. 6 E.—On the eastern side of the Middle Fork of the Feather River the timber is very poor and sparse, but west of the river there is a very good timber growth of yellow pine, red fir, black oak, and sugar pine.

T. 21 N., R. 5 E.—In Sections 1, 2, 11, 12, 13, 14, and north one half of 24 there is good timber, including sugar pine, and within a radius of a mile from Big Bend Mountain the timber is very fair, but the rest of the township has but a scattered growth of poor quality timber. The growths are yellow pine, red fir, and black oak.

T. 21 N., R. 4 E.—Only the northeastern corner of this township is in the timber belt, the rest of the township being well covered with a growth of black oak and Digger pine.

T. 21 N., R. 3 E.—This township is well covered by timber growths. White oak predominates, growing in the valleys and cañons; while the black oak seeks higher elevations and is found along the tops of ridges

and low hills. The Digger pine is scattered throughout the township. There is also considerable alder growing along the creeks.

T. 21 N., R. 2 E.—There is some white oak and Digger pine growing along the sidehills and several narrow valleys in the northeastern part of this township.

T. 20 N., R. 7 E.—North of the South Fork of the Feather River in this township the timber is very good, the sugar pine being equal to that farther north. There is yellow pine, red fir, sugar pine, cedar, spruce, and black oak, the latter being but poorly represented. South of the river the timber is of the same kind, but of a much poorer quality.

T. 20 N., R. 6 E.—The timber in this township, consisting of yellow pine, red fir, black oak, spruce, and white oak, is of a fair quality and density in the northeastern part above Sucker Run and east of the Middle Fork of the Feather River, but the rest of the township has but a very scattering growth.

T. 20 N., R. 5 E.—The timber in this township consists of yellow pine, Digger pine, black and white oaks, of a scattered growth, chiefly along the ridges and creeks. The best timber is in the east central part.

T. 20 N., R. 4 E.—Is generally covered with a good growth of oaks, and in some places there is a dense Digger pine growth.

The foothills rising on the east of the valley land are generally covered with a more or less scattered growth of oaks and Digger pine. The white oak predominates, while the blue Douglas oak and the highland live oak are also well represented. Associated with the Digger pine at low elevations is very frequently found a dense chaparral growth, consisting chiefly of California lilac and manzanita bushes.

TEHAMA COUNTY.

Tehama County lies directly south of Shasta County, and extends from the summit of the Sierra on the east to the summit of the Coast Range on the west, and covers an area of three thousand two hundred square miles.

The Sacramento River flows through the central portion of the county, which forms the northern section of the Sacramento Valley. This valley, or level land, which extends to the foothills of the Coast Range on the west, and to those of the Sierra on the east, covering an area of about two hundred and seventy square miles, is well watered by the numerous tributaries of the Sacramento River, and is covered with a scattered growth of oaks, which adds greatly to the attractive appearance of the landscape.

Tehama County is remarkably rich in her unlimited supply of pure water, which, being formed on the forest-covered mountain ranges on her eastern and western boundaries, flow in well distributed bodies through the county. The most prominent of the streams having their source in the Sierra are Battle, Antelope, Mill, Deer, and Pine Creeks.

In the western part of the county the streams are more numerous, many of them simply serving as feeders to larger streams which drain a large extent of territory. The principal creeks which rise in the Coast Range are Reeds, Cottonwood, Red Bank, Oat, Coyote, Duncan, Elder, and Thornes Creeks. All of these streams are dependent, more or less, upon the preservation of the forests at their sources for a continual and regular supply of water, and the people of Tehama County, appreciative and proud of their fine water system, should certainly respect and protect the initial condition and the natural cause which provide for them such a happy result. About two thousand square miles of this county is taken up by the lower

foothills (below an elevation of two thousand feet), which are rolling and somewhat broken, with a scattered growth of oaks and Digger pines growing upon them. These trees are used only for fuel and fencing, and as this region will in time be devoted to fruit and vine culture, the timber growths will gradually disappear. Along the streams cottonwoods, sycamores, alders, and some white maple trees flourish. The western part of the county, about one thousand square miles, is in the Sierras, and is covered with fine forests of yellow and sugar pine, red and white fir, oak, cedar, and spruce, sufficient to supply for ages even the large population which Tehama County is capable of supporting. About thirty million feet of lumber is felled each year in this county, the proportions being yellow pine, 45 per cent; sugar pine, 40 per cent; spruce and fir, 15 per cent. The total amount of lumber that has been cut in past years is difficult to estimate, but two hundred and fifty million feet would about cover it. Forest fires do considerable damage, but not so much as in former years, as the millmen take great precautions to prevent them, and are often instrumental in extinguishing them when started.

PLACER COUNTY.

Placer County lies south of Yuba and Nevada Counties, north of El Dorado and Sacramento Counties, and extends from Lake Tahoe and the State of Nevada on the east to Sacramento County on the west. It covers an area of one thousand four hundred and thirty square miles, embracing nearly every variety of surface, from the level plains of the Sacramento Valley to the high and rugged summits of the Sierras. Ranging in elevation from less than one hundred feet above the sea level to ten thousand feet above it, most any climate sought for can be found within the confines of the county.*

The western and greater portion of the county, a little more than one thousand square miles, is drained by tributaries of the Sacramento River, while the eastern portion is in the Tahoe Basin.

That portion of the county west and northwest of Rocklin, lies in the Sacramento Valley, and is, as a rule, under cultivation, and not timbered except with scattering growths, chiefly of oak. East of Rocklin, extending to the line between Ranges 10 and 11 east, the country is locally known as the Auburn and Forest Hill Divides; the former lying between North Fork of the American River and the Bear River, and the latter between the North and Middle Forks of the American River.

The Forest Hill Divide has been well timbered, but most of the timber around the mines has been cut off, and a thick growth of young pines has sprung up. On the slopes next the rivers, the timber grows densely in places. The growths are black, white, and live oak, yellow pine, pitch

*The extremes of climate to be found in Placer County is well illustrated by a story that I heard told while traveling from Auburn to Truckee on the Central Pacific Railroad, by a very popular passenger conductor on that road. He said: "Some years ago I attended a meeting of railroad conductors held in the East, and one day while enjoying ourselves at an old fashioned clam-bake, several of the boys began to tell wonderful stories of the sights to be seen on their respective runs; each tried to outdo his neighbor in piling it on, and some of the lies that those fellows told would have made Eli Perkins blush. Finally it came my turn, and I quietly stated that I was out in California on the Central Pacific, and that I started in the morning from one end of my run (Truckee) where the snow was ten feet deep, and in five hours I was in the midst of oranges, grapes, and beautiful flowers, all growing out of doors and in full bloom. There followed a general silence, no more experiences were related, and do you know those fellows put me down as the boss liar, when I was simply telling the plain, unvarnished truth, as any one who has traveled from Truckee to Sacramento at certain seasons of the year can testify."

pine, and some sugar pine. The Forest Hill Divide is greatly cut up by deep and precipitous cañons, and ranges in elevation from six hundred to three thousand five hundred feet.

The Auburn Divide, from two hundred to three thousand five hundred feet in elevation, is made up of undulating valleys, gently sloping foothills, high hills, and mountains, and covers an area of about two hundred and seventy-five square miles. This is the fruit region of Placer County, and its fame is too well known to need further comment. This region has been pretty well cut over, especially where cultivated and in the vicinity of mines, and everywhere a heavy second growth of pine has sprung up. Towards the Bear and American Rivers, the timber is generally better than elsewhere. The growths are black and white oak, yellow and Digger pine, and some sugar pine. There is no white oak above Township 15 north. In the northeastern part of the divide the timber is of larger growth. East of these two divides, and to the summit of the Sierras, the country is rough and mountainous. The northeastern portion is well timbered. T. 16 N., R. 11 E., on the east side of the railroad, next to the river, is covered with good yellow pine, pitch pine, sugar pine, white fir, black and live oak. On the side west of the railroad the timber has been mostly cut off.

In T. 16 N., R. 12 E., there is heavy yellow pine, pitch pine, sugar pine, spruce, and red fir. T. 16 N., R. 13 E., is well timbered, especially on the southern half of the township, with yellow pine, pitch pine, red fir, and tamarack. There is also some spruce and sugar pine.

T. 16 N., R. 14 E., is covered with the same kind of timber as the last township.

The rest of this region is not so well timbered, the best growth having been cut off, portions of it being very wild and rugged. On the east slope of the Sierras the timber has been of very heavy growth, but considerable of it has been cut. In T. 17 N., R. 15 E., there is a good deal of heavy red fir, white fir, and yellow pine, also black pine and tamarack, except in the southeastern part (Secs. 24 and 25), where it has been well cut over.

T. 17 N., R. 16 E., has been all cut over, little but firewood having been left.

T. 17 N., R. 17 E., is well timbered, where it has not been cut over (about one half of township), with red and white fir, and yellow and black pine. Wherever red fir grows it is the prevailing timber.

T. 16 N., R. 16 E., has been pretty well cut over, except a patch of about six square miles in the eastern part of the township, of good red fir, yellow and black pine. T. 16 N., R. 17 E., is about half cut over, the timber remaining being good red and white fir, yellow pine, and black pine. T. 15 N., R. 16 E., has only been cut over in the southeastern corner, the rest of the township being well timbered with red and white fir and pine. T. 14 N., R. 16 E., is a rough mountainous region, but even here the timber has been cut when at all accessible.

East of the summit of the Sierras, the black pine grows abundantly, seeming to flourish as well on rocky ridges as on lower and more moist ground. Extending from Sierra Valley to Lake Tahoe, and from the State of Nevada to the Summit of the Sierras, lies the so called Truckee Basin, on which there is now standing about three billion feet of saw timber, consisting of yellow, black, and sugar pine, red and white fir. Most of the lumber felled in this basin is sawed at Truckee or in the vicinity, and amounts to between forty and fifty million feet per year, of which fir forms nearly half of the cut, and yellow pine about 35 per cent. The second

growth in this basin is generally the same as the original. Considerable damage is done by forest fires.

SIERRA COUNTY.

Sierra County is bounded on the north by Lassen County, on the east by the State of Nevada, on the south by Nevada County, and on the west by Plumas and Yuba Counties. It covers an area of eight hundred and fifty square miles, the greater portion of which consists of high mountains and table lands, the eastern half of the county being over four thousand feet above sea level, and the western half, which embraces a rugged and broken country, having an elevation of over two thousand feet.

The chief industries are mining and lumbering, the winters being too cold and the area of tillable land too small to farm much. The entire county may be said to be timbered, a portion of Sierra Valley being the most notable exception. With snows thirty or forty feet deep in winter, the firs naturally flourish in this county, and at high elevations form the greater part of the forests. The principal forest growths are red fir, white fir, yellow and black pine, spruce, cedar, and sugar pine. The black pine grows chiefly on the east slope of the Sierra, especially around the south end of Sierra Valley. The wild plum grows profusely throughout the county, and the fruit is largely gathered and made into preserves.

There are eight sawmills in Sierra County, and they cut about fourteen million feet of lumber each year. A great many logs are taken out of this county and sawed at Truckee. About one million five hundred thousand feet of shingles and shakes are made each year.

Much of the timber in this county is situated in such inaccessible localities that it would not pay to cut it, so it will probably be allowed to continue its service as a protector to the vast watersheds of the North and Middle Yubas.

NEVADA COUNTY.

Nevada County is bounded on the north by Yuba and Sierra Counties, on the east by the State of Nevada and Placer County, on the south by Placer County, and on the west by Yuba County, and covers an area of one thousand and sixteen square miles, or six hundred and fifty thousand two hundred and forty acres.

The Sierras extend across the eastern portion of the county, and a little more than half of its entire area consists of mountainous land. The west slope of the Sierras descends more or less gradually from an altitude of eight thousand feet on their summit to the foothills, which cover the southwestern part of the county, and is well drained by the Middle and South Forks of the Yuba and the Bear River. The foothill region in the western part of the county covers an area of about four hundred square miles, and except on its eastern border, where the low spurs of the Sierras extending westward causes it to be very broken, is very fertile, and is fast becoming celebrated for its fine fruit.

Nevada is essentially a timbered county, and even at the present time presents little but a wooded landscape to the eye. The western portion of the county was originally covered with a thick growth of Digger pine, white oak, black oak, and yellow pine, but most of it has been cut, either for use in the mines or by settlers clearing land for agricultural purposes. Around Grass Valley and Nevada City, within a radius of five miles from each place, all of the original timber has been cut off, and is now replaced by a dense growth of young pine (second-growth pine). In

fact, over the entire country west of the Sierras, wherever pine timber has been cut off, a dense growth of "second-growth pine" has sprung up in its place.

The scattered growths in the extreme western portion of the county can be separated from the more heavily timbered region by an imaginary line starting at the southeast corner of T. 14 N., R. 8 E., and running directly north for twelve miles; thence northeast to where Rush Creek empties into the South Yuba River; and thence northeast to the junction of the North Yuba and the Middle Yuba Rivers.

All of the county west of this line is covered with a scattered growth of Digger pine, white oak, yellow pine, and black oak. Manzanita and underbrush grows nearly everywhere. Very few yellow pine or black oak trees are seen in the western half of the foothill region, but they become more numerous as the dividing timber line is approached.

East of the dividing timber line and extending to the summit of the Sierras, the entire country is covered with a timber growth of greater or less size and density, the principal species being yellow pine, red fir, black oak, sugar pine, spruce, live oak, tamarack, white fir, and hemlock.

East of the summit of the range, the timber has been pretty well cut over, but where it is still untouched, it consists of heavy red and white fir, pine, and tamarack. Truckee has long been a lumbering center, and naturally the timber nearest to hand was cut first.

There are fifteen sawmills in Nevada County, with an estimated cut of fifty million feet, board measure, per year of yellow and sugar pine, fir, cedar, and spruce. There has been about as much timber used in the mines of this county as has been sawed by mills. When using steam power, the mines burnt pine fuel entirely, but now water power is used.

The residents of the western part of the county use oak wood for fuel, and but little pine. Forest fires have been quite destructive, two years ago burning from Bloomfield northeast over a large area in Tps. 18 N., Rs. 10 and 11 E. It was supposed to have started from sheepherders' camp fires, as this is a district into which sheep are driven in summer.

AMADOR COUNTY.

Amador County lies between the South Fork of the Cosumnes River and the Mokelumne River, and extends from Alpine County on the east to the Sacramento Valley on the west. It covers an area of five hundred and sixty square miles, of which about four hundred and fifty square miles belong to the lower foothill region, composed of rolling hills and numberless flats, and generally timbered with a scattering growth of oaks and Digger pines. The eastern part of the county is very narrow, and from Volcano to the eastern boundary is generally covered with timber, yellow pine, Sugar pine, black pine in the extreme eastern part, and firs being the principal growths. In the vicinity of Ham's Station, the sugar pine belt of the eastern part of El Dorado County extends through Amador County, the trees being of large growth, some reaching a height of three hundred feet, and a diameter of twelve or thirteen feet. Volcano was a prosperous mining camp in early days, and considerable mining was done in the vicinity, and around these mines the timber was pretty well cut off, and is now replaced by a vigorous second growth. Not a great deal of lumber is being cut in this county, but the shake-makers in the eastern part of it seem to carry on a profitable business.

EL DORADO COUNTY.

El Dorado is bounded on the north by Placer County, on the east by the State of Nevada and Alpine County, on the south by Amador County, and on the west by Sacramento County. It covers an area of one thousand eight hundred and fifty square miles, of which about one thousand and fifty square miles are in the Sierras, the remainder being lower foothill and valley land. This county is watered by the Cosumnes and American Rivers and their tributaries. On the western border of the county is a strip of treeless level land or valley, from which the country slopes gradually upwards towards the east, first undulating, then hilly; and finally, at a distance of nearly thirty miles, it becomes broken and rugged, and joins on to the Sierras. This section is covered by a scattered growth of white and black oak, with Digger pine near its western boundaries, and more or less extended patches of buckeye, manzanita, and chaparral.

Fruit and vines have already been extensively put out in this region, and have met with such remarkable success that no doubt all of the availble area will be devoted to their culture. The rest of the county, from the eastern boundary to within about fifteen miles of Placerville, is in the Sierras, and generally well timbered. On the east slope of the Sierras yellow and black pine and fir are the chief growths, while on the western slope, which is more heavily timbered, yellow and sugar pine prevail, with a good growth of fir and cedar. In the northern and eastern parts of the county there are several fine belts of sugar pine, noticeably around Pi Pi Valley and Georgetown. The timber that has been cut was entirely for local uses, but no doubt cheaper transportation for lumber will soon be procured, and the valuable pine forests will be utilized for lumber. This county possesses a fine irrigation system, hundreds of miles of canals carrying water over its surface. The principal supply of water is obtained from a series of small lakes lying in the high Sierras, which drain a large forest-covered watershed above an elevation of six thousand feet, and are fed throughout the year by melted snow.

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THIRD BIENNIAL REPORT

OF THE

CALIFORNIA STATE BOARD OF FORESTRY

FOR THE

YEARS 1889-90,

TO

GOVERNOR R. W. WATERMAN.

MADE IN ACCORDANCE WITH THE PROVISIONS OF SECTION FIVE OF AN ACT "TO CREATE A STATE BOARD OF FORESTRY, AND TO PROVIDE FOR THE EXPENSES THEREOF," APPROVED MARCH 3, 1885.

SACRAMENTO:
STATE OFFICE, : : : : : : : : J. D. YOUNG, SUPT. STATE PRINTING.
1890.

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ILLUSTRATIONS.

Prepared by J. G. Lemmon and wife. Artotyped by Britton & Rey, San Francisco.

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AN ACT

To Create a State Board of Forestry, and to Provide for the Expenses Thereof.

[Approved March 3, 1885.]

The People of the State of California, represented in Senate and Assembly, do enact as follows:

Section 1. There shall be established a State Board of Forestry, consisting of three persons, appointed by the Governor of the State.

Sec. 2. Each member shall hold office for the term of four years, and until his successor shall be qualified.

Sec. 3. The Board may appoint and prescribe the duties of its Secretary, and elect one of its own members Treasurer, both to hold office at the pleasure of the Board.

Sec. 4. The duty of the Board shall be to collect statistics and other information with regard to forestry, tree culture, and tree preservation, throughout the State; to correspond with various forestry societies and individuals, for the purpose of obtaining such information; to learn by investigation and experiments the adaptability of various trees to the different sections of the State; to disseminate such information throughout the State in such a manner as to aid and encourage the purpose for which this Board is formed; to assist in enforcing and carrying out all national and State forestry laws, as far at practicable; to act with a special view to the continuance of water sources that may be affected in any measure by the destruction of forests near such sources; to do any and all things within their power to encourage the preservation and planting of forests, and the consequent maintenance of the water sources of the State.

Sec. 5. The Board shall report biennially to the Governor a detailed statement of its work, which shall include all disbursements that may have been made. All printing required to be done by the Board for their official use shall be done by the Superintendent of State Printing.

Sec. 6. There is hereby appropriated for the use of this Board, out of any moneys in the State Treasury not otherwise appropriated, the sum of five thousand ($5,000) dollars for the two years beginning the first of April, eighteen hundred and eighty-five, said sum to be used for the payment of the salary of the Secretary, not to exceed the sum of one hundred and twenty-five dollars per month, the necessary traveling expenses of the members of this Board, the employment of assistants, and such other needful expenditures as this Board may incur, and the State Controller will draw his warrants on the State Treasurer in favor of the Treasurer of the Board for the same.

Sec. 7. The members of this Board shall receive no compensation.

Sec. 8. All Acts or parts of Acts in conflict with this Act are hereby repealed.

AN ACT

To Enlarge the Powers of the State Board of Forestry, and to Provide for the Expenses of said Board.

[Approved March 7, 1887.]

The People of the State of California, represented in Senate and Assembly, do enact as follows:

Section 1. All the members of the State Board of Forestry of this State, and all assistants now employed or hereafter to be employed by said Board, are hereby endowed with all the powers of peace officers, for the purpose of making arrests for any violation of any law applying to forest or brush lands within this State, or prohibiting the destruction thereof.

Sec. 2. There is hereby appropriated for the use of this Board, out of the moneys in the State Treasury not otherwise appropriated, the sum of twenty-nine thousand five hundred dollars for the two years beginning the first of April, eighteen hundred and eighty-seven, said sum to be used for the payment of the salaries of the assistants of said Board, the necessary traveling expenses of the members of said Board, and such other needful expenditures as said Board may find necessary, and the State Controller shall draw his warrant on the State Treasurer in favor of the Treasurer of the Board for the same.

Sec. 3. This Act shall take effect and be in force from and after its passage.

COMMISSIONERS' REPORT.

To his Excellency R. W. WATERMAN, *Governor of California:*

Your Board has the honor to report a good measure of success attending the various operations conducted by it during the past two years.

Increased attention has been given to the forest fire service and development of resources looking to the permanency of present and rehabilitation of depleted forest areas. Our best energies have been enlisted in the effort to induce some action from the general Government tending to a proper administration of their timber lands within this State, as much a matter of public policy as of equitable relief to our people and your Board, upon whom is now imposed the onus of combating the destructive agencies at present tolerated upon the Federal territory.

To this end we drafted a memorial to Congress synoptically setting forth the urgency of the plea, embodying a few of our most salient grievances and outlining suggestions for their redress.

No legislative action has as yet flowed therefrom, but this Board recognizing that the community of interests in all forest lands are so inseparably interwoven as not to admit of the pursuit of divergent forestry methods, and that however useful as such may be the arbitrary lines of demarkation which define individual, State, or Federal ownership of forest lands, they must be disregarded in the operations of any rational, comprehensive, and successful system of forest management.

Hence our agitation of this subject as affecting the public domain in its relations to our State lands, shall be conscientiously and continuously persevered in until the recognition we demand is granted and the nation redeemed from the stigma attaching through its inertia in the matter.

It is a pleasure to record in connection with this memorial (which is incorporated within our report) the persistent efforts of our Representatives in both houses of Congress to secure us enactments in accordance with its recommendations, and the united and loyal support tendered us by the general public and the entire newspaper press of the State.

Much of this support has been voluntary and unsolicited, an encouraging sign of an intelligent and patriotic interest in the issues at stake, and of appreciation of our efforts to advance them.

Chiefly through our instrumentality and the unsparing efforts of Hon. Wm. Vandever, a portion of the public domain embracing lands upon which are situated the famous California big trees, have been withdrawn from sale and dedicated as national parks. The threatened destruction of these remarkable and isolated groves of forest giants was most imminent, and their extermination would have been one of the public disasters of our generation. They are now safe from the woodman's ax, but they still are guaranteed no immunity from fire, and one of the first acts of this Board upon the reconvening of Congress will be to urge the adoption of a measure supplementing the good work already begun by making provision for their complete guardianship against other sources of danger.

Continuation of the forest map work, a conspicuous feature of our previous reports, has with propriety been temporarily suspended.

All the forest areas of California have recently been sharply and intelligently defined, and maps illustrating their limits, density, and species, and timber and fuel value, have been issued by the Department of the Interior under the direct supervision of Prof. S. C. Sargent, which, of itself, is a sufficient guarantee of the highly scientific and practical character of the work, while in the detail of mechanical execution nothing is left to be desired. It is hardly possible to overrate the value of this work, without doubt the most finished and exhaustive contribution to forestry of this or perhaps any era.

It is not within the limit of probabilities that accessions to the timber lands either through natural or artificial means, or their disappearance through destructive forces during the next few years, will be on a scale of such magnitude as to materially impair the usefulness and accuracy of these maps; whenever such becomes apparent, this function of our work will be resumed.

For cognate reasons, the purely botanical work of the Board has been abridged and confined to some addenda to and revisions of the pines, as skillfully and conscientiously elaborated at the hands of Mr. Lemmon. The indefatigable efforts of the Botanical Staff of the California Academy of Sciences, and the zeal of the half score of individual collectors, have, through the medium of scientific publications of the day, brought into prominence every recent contribution to dendrology of interest to this coast.

The scientific and economic value of most of our native species has been fully determined, and profitable results in the interest of immediate reforestation can be better expected of those species whose limits, habits, and known requirements are now familiar to us, than of new, untried, or little known native kinds.

The two great orders, the Coniferæ (cone-bearers) and the Cupuliferæ (acorn-bearers), and which constitute nine tenths of all the woodland wealth of California, have been thoroughly exploited; the former in the unparalleled monographs of the late Dr. Englemann; the latter, at the scholarly hands of Prof. Edw. Lee Greene, of Berkeley, Cal.

It is fitting that this Board should acknowledge the benefits arising from, and the knowledge of tree lore to be derived from the study of "Kellogg's Oaks"—a knowledge only made accessible through the private liberality of Dr. McDonald, of San Francisco, and skillful and masterly revision by Professor Greene; a California enterprise in every particular, it is an encouraging exponent of the sentiment of our people in becoming fully aroused to the importance of every detail affecting forests or forest interests.

New considerations arise or are daily brought to our notice, impressing us more strongly than ever with the beneficial results to the State that may ultimately be expected to flow from systematized forestry. Hitherto, arguments in this line have been mainly directed to investigation of the uses of our forests as conservators of favorable climatic conditions; as perpetuators of our water sources, and as the field of continuous supply for our lumber mills and correlated industries. While these considerations are and ever must be paramount to all others, yet their merits and importance have been so exhaustively dwelt upon in

previous reports that it becomes a work of supererogation to more than reaffirm them here.

Yet another consideration, and one upon which insufficient stress has heretofore been laid, and which appeals to us as strongly through our pockets as our hearts, is the urgent necessity of maintaining intact from vandalism the unequaled beauty of our California forests.

Our State is fast becoming a world-famed center for tourist travel and both winter and summer resort. "Accessibility to the redwoods or the timber country" has now become one of the stereotyped inducements to travelers and patrons of many of these resorts, and the unsurpassed grandeur of these forests has been and must for all time continue to be a prominent feature in the attraction of visitors to our State, whose presence is a conceded benefit to us all.

This class is further augmented by those who seek the mountains for purposes of sport. So jealously has the State guarded the interests of the native fauna, that the statute books are weighted down with provisions against their possible extinction in every particular save one.

The propriety of this does not admit of dispute; not alone in the interest of those who desire the health and recreation incident to field sports, but in defense of that hardy and independent class who look to the product of the rod and gun for a livelihood, or to the forests as furnishing an unfailing food supply when all other means are exhausted.

In the passage of many wise and conservative measures having a single eye to the importance of this question, the one thing above excepted, and which seems to have escaped the vigilance of framers of laws protective to fish and game, is the danger to both in our constantly recurring forest fires. Large game driven out and away from the shelter of the timber; smaller species and the young of all burned up in countless numbers.

Close seasons for game fishes are rigorously prescribed, and with but few violations are generally observed, yet continuous and unabated open seasons are fraught with less danger of extermination to the finny inhabitants of any stream than the destruction by fire of its timber-sheltered watershed; the uniformity of the flow, the coolness of the waters, and the supply of food are all enhanced by the adjacent forest—materially impaired and endangered by its loss.

These are considerations of sufficient gravity to warrant us in believing that all interested directly or indirectly in the preservation of the fish and game of this State from extinction will heartily coöperate with us wherever possible to avert the most serious danger to which they are exposed.

THE LUMBER INDUSTRY AND INTERESTS.

For many years and with good foundation, the lumbermen of the State were arraigned for injudicious cutting and needless waste of timber in their logging operations. The still fallen but now unserviceable monarchs of the forest in places accessible to mill work, bear mute but unimpeachable testimony to the truth of these charges. Now, it becomes a pleasure to record not only a general reformation in this particular, but to know that in some districts waste of any kind is reduced almost to a minimum.

Errors by the most experienced loggers will sometimes result in the falling of a tree unsuitable for sawmill uses; but this loss is offset by

the more general economy now practised in utilizing what was once waste material.

In the San Bernardino District, five mills convert the main cuts into building material; the upper cuts they turn into fruit-box lumber, and, to complete the good work, they are followed by charcoal burners, who utilize the tops and branches until not only is every vestige of the crop profitably converted, but the consumption of the inflammable debris results in providing an assurance against fire, worth more than all other preventive or remedial measures combined. No other heavily cut-over timber belt in the State is now so free of logging refuse as this, and, as a proof of the assertion made above, none have for some years past been so exempt from extended or progressive fires. The result is a far-reaching, spontaneous second growth of superior quality and of unparalleled thrift and vigor. So pleasing is the contrast presented with some of the periodically fire-swept districts, that it becomes pitiable to contemplate the disaster that would here follow in the wake of an established fire.

Nearly one half of this territory in question is still land of the Federal Government, and the felonious negligence which tolerates and leaves to the hit-or-miss game of chance the escape or destruction of these struggling and promising forests, becomes a crime that cannot be condoned, but only the subject for our reproach, rebuke, and condemnation by future generations.

To the lumbermen and millmen must be accorded hearty commendation for the unsparing and self-sacrificing efforts they now put forth for the repression of fires.

Not infrequently work in the best of the season is completely suspended and all hands repair ten, twenty or more miles to combat an incipient blaze, and this Board gratefully recognizes the efficiency and value of the services rendered.

Self-interest cannot be alleged as their only incentive. None know better than the millmen that the mature and largest timber is seldom destroyed by even the hottest fires; that it is the trees of one foot in diameter and downward that are the doomed victims; none know better than they that generations must elapse before those destroyed could become merchantable products; none more cognizant than they that the burning out of this second growth and underbrush facilitates and lessens the expense of their logging operations.

Only in the case of large, stationary mills, whose plant embraces a costly system of flumes and tramways for the handling of distant timber, can fires be otherwise than a distinctive gain; yet of many fires investigated, in only one isolated case can even suspicion attach to any mill owner or employé, and in that instance the resulting damage from inability to control will be an ample deterrent for the future.

Hence it becomes a pleasant duty to aggressively maintain in behalf of the guild at large, that self-interest alone has not actuated them in this course, but that consideration for the rights of others has been equally instrumental—to pledge them our assistance, and to leave no resources untried to secure them the relief which in equity and justice they are entitled to at the hands of the general Government.

With the gradual adoption of close economies, with reasonable care in the selection of trees, and the reduction of all unnecessary waste, it seems to us that the lumbering interests of the State will continue

to flourish long after the time allowed by the statisticians of the Department of the Interior.

Such may not be the case with the redwood forests, of which nearly every available stick of timber has been measured, and if the ratio of increase of our export trade is maintained, in less than forty years our redwood forests will exist but in theory. Still, upon the Sierra Nevada side of the State the lumber resources seem to be boundless, and to endure for all time.

Some of the largest mills, whose individual output is ten million feet (B. M.) per annum, still have within reach, and without taking stock of anything except the best and most accessible timber, enough to supply their full capacity for one hundred and fifty years to come.

These mills are few in number, and vast stretches of forest of the finest quality in Plumas, Sierra, and Lassen Counties, have never yet been assailed by the lumbermen, and whose productive capacity is almost beyond the computation of figures.

Further, as the result of recent close and painstaking examinations of some of the most heavily cut-over timber belts upon the crests of the Sierras in Butte, Tehama, and Nevada Counties, it is our carefully digested opinion that legitimate lumbering as now practised there, nor the results of more reckless operations in the past, give any evidence tending to show that the continuation of present methods, or extended operations in the future will impair in the slightest existing hydrologic conditions.

For this fortunate state of affairs we are not indebted to the lumbermen, but to the happy arrangements of Nature, whose distribution of species has been so effective that only about one third of this forest cover is available at present for millmen's wants.

Much of this territory, in fact most of it in the districts referred to, has been stripped long ago of its Sugar Pine (*P. Lambertiana*); since then a return has been made for the Yellow Pine (*P. ponderosa*), and more recently still another inroad for the best of the Spruce (*Pseudotsuga Douglasii*); but there still remains a magnificent growth of the Balsam, Red Fir, and Flat-Leaved Cedar, which, however valueless at present from the lumberman's standpoint, as fully and completely subserves the preservation of the conditions dependent upon forest covering as their more coveted but no whit more useful timber coöccupants would have done.

Indeed, except for the occasional telltale stump, the inexperienced may walk or ride for many miles upon the most important watersheds of the mountains, at points where many basins concentrate to form the beginning of our chief watercourses, and be impressed with the idea that he is traveling through the virgin forest.

The exhaustion of the more esteemed species may, in time, compel the lumberman to return for these now neglected sorts, but by the time the standing spruce and pines of these hyperborean counties have been used up, the now flourishing second growth of young timber will be ripe for the ax, and another long renewal of the prosperity of our lumbering industries.

This, always presupposing that at an early day some adequate means will be found of coping with the fire evil, and that young forests of twenty to forty years' growth will not be swept from the face of the

earth with no more consideration than would be accorded to so many noxious weeds.

TRADE.

The volume of our lumber trade is fast increasing, and rapidly rising to the front rank in importance among our business enterprises. New avenues of export trade are being daily developed, the increment from year to year showing a remarkable and steady gain. Wherever our native redwood has been introduced it has met with most flattering success, and on its merits secured a footing and created a demand that not even the imposition of foreign import duties against it can succeed in abating.

As a general all around utility lumber, it readily takes second place among all known timber trees, yielding first rank only to the perhaps doubtful supremacy of *Pinus strobus*, the common eastern White Pine.

An illustration of its merits and popularity is quickly shown by the fact that it is now on sale by many dealers in the Eastern United States, and again that our traffic in this article with the Australian Colonies has grown within recent years to large proportions despite a constant issue of Government publications claiming to show a diversity and value of native forest products, all sufficient to supply all possible domestic wants.

The statistics of our trade with the colonies, now being collated by the Forester, through the courtesy of the United States Custom House at San Francisco, and which will be shortly issued as a supplement to this report, will not only show our chief foreign markets, and the remarkable increase in the trade since the last publication on the subject by the National Bureau of Statistics, but seem to indicate that Australians are becoming practically aware of the great superiority of our woods for general building purposes, and make more eloquent appeal to us in behalf of careful forest management than any words can do.

The drain upon our redwood resources, for domestic uses alone, is enormous, exceeding two hundred million feet (B. M.) a year, and our success in holding forever the far West Pacific trade now tributary to us, depends upon our vigilance in maintaining the reproductive character for all time of these fast diminishing storehouses of our wealth.

In the matter of these redwood forests, so remarkably confined to a minute fraction of the earth's surface, and to a limited zone even in California, their extension in area through natural agencies is improbable to the last degree; hence, it seems that their almost sempiternal powers of reproduction from the root was an endowment directed solely to the end of neutralizing the war of extermination that has been waged upon them during the past forty years.

That this power of self-reproduction from the stem is not eternal we now unfortunately know to be true.

After felling the trees, the subsequent growths have been burned over and destroyed and new shoots have appeared. This process has occurred in some localities twice, and the parent root has responded once more in the supreme effort to reassert its indestructible character; but in most cases where a third time they are assailed by flame, the vitality of the tree succumbs, and the charred but undecaying stump remains for all time a monument to our egotism and shame.

It is to be hoped that if the setters out of fires in the redwoods antici-

pate the full measure of forgiveness to be accorded them for seventy and seven misdeeds, it is to be devoutly wished that the whole of the older scriptural doctrine may prevail, and that a generous supply of the seventy-eighth fire may be kept in perpetual ignition for their exclusive benefit.

Our southern redwood belt, *i. e.*, the redwood-producing district of San Mateo, Santa Clara, and Santa Cruz Counties, having been extensively cut over prior to the invasion of the northern counties by lumbermen, presents a better field for more accurate determination of the future prospects of this important tree than can be predicated of its ultimate status farther northward.

Here upon the seaward side of the Coast Range are still large and valuable bodies of uncut timber, but from the eastern slopes of these mountains which align nearly the whole length of the Santa Clara Valley, every stick of timber has been cut for more than twenty years past; railroad facilities, and the nearness of many flourishing towns having furnished a market for every product including fuel, with the result of leaving a "clean up" not exhibited in any other part of California. Even the Tanbark Oak (*Quercus densiflora*), originally associated with it in great quantity, has been cut out, and lacking the regenerative powers of the redwood has practically disappeared.

The largest part of this field is now covered with a second and third growth of great density and vigor, careful inquiry from residents showing that upon areas from which the redwood has completely disappeared is that which within their knowledge has been burned over three or more times.

The natural habitat of the tree is confined to good soil, its greatest development occurring upon lands of great depth and fertility; and striking illustrations of the erosions and washing away of large tracts of fruitful lands in these burnt and reburnt districts abound to the westward of Menlo, Redwood City, and San José. None such are visible upon lands protected by a secondary growth of not above twenty feet in height. These hillsides in many cases are exposed to bedrock, bereft of all soil and utterly and forever unfitted for the natural or artificial propagation of most trees, and certainly for the best of all—the redwood.

The greater demand for this lumber, its narrower limits, the greater time required to perfect its maturity, all indicate what in our judgment does not hold true of the northern Sierra forests, to wit: its early exhaustion for commercial requirements alone. The cleanness with which these forests are cut further presents a menace to our climatic future, which, as we have shown, does not exist in our interior timber country; hence if we are to be in nowise influenced by consideration concerning the future lumber supply of the next generations, at least the gospel of self should urge upon us such means as will maintain, unimpaired, our water supply and contingent benefits, when the only obligation exacted is vigilance in seeing that the axman's work is not supplemented by fire.

FOREST FIRES.

In this particular, and with many disadvantages to labor under, we have to commend the activity of our agents, and to note that the State has been very generally posted with the customary fire notices, and our

attention has frequently been called to instances where this formality has at least exercised a restraining and salutary influence.

In several cases arrests have been had of suspected violators of the law, but prosecution failed for lack of evidence or the inefficiency of the statutory enactments relating thereto.

We shall again submit to the Legislature recommendations for the amendment of these laws, increasing their stringency, and requesting a joint resolution urging upon the Governor of the State the necessity for an annual proclamation, which shall recite the law upon the subject and offer adequate rewards for the conviction of its violators.

Such action will secure widespread publicity, and tend to convert the residents of our wooded districts into a volunteer constabulary, whose presence and watchfulness would have a restraining effect upon evildoers.

Those engaged in clearing their own lands, and through whose culpability fire extends beyond their own limits, should not be held guiltless, but be dealt with as rigorously as willful offenders; nor be permitted to jeopardize the lives and property of others through their negligence.

A force of Fire Wardens is maintained by the State of New York for the guardianship of the Adirondack region and the timbered watershed of the Hudson at considerable cost, but with a heavy balance to the credit of the Forestry Board in the value of public and private property saved from loss.

So far as practical, we have endeavored to establish a similar service; but, in view of the enormous territory under supervision, no fully effective results could be expected that did not entail an expenditure of $100,000 per annum. Even then, no service could be prolific in results that did not aim to subdue *all* fires in the timber district, wherever or however originating, and irrespective of individual, State, or Federal ownership; and it becomes a moot question to determine if even the higher law of necessity and self-preservation is sufficient to justify the recommendation of a policy of burdensome taxation upon ourselves to make good the Federal shortcomings, and preserve, at our cost, the timber integrity of the public domain.

The President of the United States, impressed with the importance of this matter, submitted a message to Congress urging upon that body the necessity of some provision to properly police these lands; and correspondence has been had by this Board with the Department of the Interior, urging our claims for recognition in event of such provision being made.

If successful in this issue, by close coöperation of State and Federal authorities, we confidently believe that our fair State can at an early date be redeemed from the plague of forest fires; or their mischievous results, if not wholly abated, reduced to inconsequential losses.

EXPERIMENTAL FORESTATION.

Planting of State lands devoid of trees, or reforestation of those from which the timber has been stripped, and which, from default of final payments, have reverted again to the State, though most pertinent to the functions of this Board, cannot be undertaken until all danger from

the fire nuisance and roving bands of sheep engaged in stealing pasture be fully abated.

Further, to insure a continuous policy of successful scientific management, these lands should be deeded in trust to this Board and its successors, until such time as they are restored to a paying condition, and the income derived therefrom may be disposed of as directed by the Legislature. Your attention is again called to the iniquity of the school land law as it now stands, the details of which have been fully ventilated in our previous reports.

Briefly, the law was ostensibly framed in the interests of the public schools as a means of providing school funds; practically, it operates chiefly to enrich a few timber speculators, who can strip the land of everything of value, and throw it back unpaid for to the State in a condition that will require generations for its restoration to useful or productive ends.

The patriotic popularity of any measure directed for the *apparent* benefit of the schools, when backed up with a little cheap claptrap, always goes with a rush and without too close scrutiny into the merits or demerits of the question at issue. Such has been the case with the present law, which promised much upon its face, but in practice has become a farce, and permits not only the reckless spoliation of the forests, but has impaired beyond redemption the integrity of one of the grandest endowments in the cause of free education ever conceived by this or any other country.

For the reasons given above, our experimental work has been chiefly confined to the introduction and dissemination of forest trees and seeds that, after testing upon our station grounds, give promise of sufficient utility and value to justify their transplantation to other parts of the State.

Investigations have been had with the single end in view of encouraging the planting of so called waste lands for the purpose of redeeming from aridity, and reclaiming to forestry, lands wherever situated unsuitable to general or special agriculture.

We have made our experimental stations the vehicle for the gratuitous distribution of both seeds and young trees from Del Norte to San Diego, and embracing with two exceptions every county in the State.

Our distribution is made in a way not to conflict with the interests of the nurserymen or commercial dealers, but to the contrary, as our many testimonials show, to their marked advantage in promoting a demand for their products which our recommendations have created.

It is not amiss to cite here a single instance, that of the Sugar Gum (*Eucalyptus corynocalyx*), which, though not originally introduced into the State by this Board, through it received its first impetus and widespread introduction throughout Southern California. We are now informed through many sources that the energies of both seed men and growers are taxed to the utmost to supply the demand for this most useful tree.

Two of our stations are now in a high condition of improvement, alike instructive and beautiful. The requirements of the last Legislature have been fully complied with, and the State now holds in fee simple title to two most valuable properties; one located at Chico, the other at Santa Monica, worth, with the nursery stock and improvements thereon, in the aggregate not less than $40,000.

Desirable sites at intermediate points, including valuable water rights, are tendered the State free of cost, for the establishment of other stations for the development and stimulation of forest tree planting. Acceptance of these stations depends upon the action of the Legislature in making proper provision for their maintenance and support. Unless this be done, the Board cannot in good faith accept them at the hands of the donors.

The esteem and popularity in which this branch of our work is held, and the very general interest it has aroused in every quarter of the State, is evidenced by the increasing number of visitors to our stations, and the voluminous correspondence which has grown up in connection therewith during the past year; an interest intensified by the ambition of our citizens and land owners to redeem and convert sterile and unproductive hills into profitable and beautiful features of the country; to make plantations that shall not alone yield the fruits of industry and skill, but concurrently add their quota to assist in maintaining the climatic equilibrium so essential to retain in order that California may continue to enjoy the supreme distinction as the possessor of the most perfect climate in the world.

This Board is indebted to, and desires to make general acknowledgment to their many correspondents, whose zeal and services have encouraged and aided us in spreading the gospel of tree planting. For especial services in the matter of painstaking reports, the undertaking of unpromising experiments, for donations of seeds, trees, and many valuable publications, we are under obligations to Hon. Wm. E. Alvord, of San Francisco; Congressmen Morrow, Clunie, and Vandever; B. E. Fernow, Chief of Forestry Division, Washington; Forest Commissioner E. T. Ensign, of Colorado; Mr. Frank E. Gallaher, of Santa Barbara; C. E. Mohr, of Pleasanton; Abbot Kinney, of Lamanda Park, and Prof. E. W. Hilgard; to the Forest Departments of both France and Austria, for their reports; and for seeds and reports from Dr. Schomburgk and J. Ednie Brown, of Adelaide, of South Australia; to Baron F. von Mueller, Government Botanist of New South Wales, and Mr. F. M. Bailey, Director of the Botanic Gardens of Queensland, Australia. To these latter four gentlemen we are indebted for seeds never heretofore introduced into California, and which give early promise of ready adaptability to many parts of the State.

Our unqualified appreciation of the efficient and concientious services of the officers and agents of the Board is freely expressed; services highly instrumental in bringing this institution to the degree of usefulness and importance generally accorded to it by the people of the whole State.

WALTER S. MOORE, Chairman.
J. D. SPRECKELS, Treasurer.
F. J. MOFFITT.

FINANCIAL REPORT OF SECRETARY.

ROOM NO. 35, FLOOD BUILDING,
SAN FRANCISCO, CAL., January 1, 1891.

To the Commissioners of the State Board of Forestry:

GENTLEMEN: I have the honor to submit herewith a report of the finances of the Board for the two years ending January 1, 1891.

The Legislature appropriated for the uses of the Board of Forestry for the years 1889–90 the sum of $30,000, which amount, by the experiences of the past two years, has proven entirely inadequate for the work the Board proposed to undertake. With this sum, however, the Board has accomplished a great deal in the way of tree planting and forest preservation, as the report of the Head Forester, and an inspection of the Experimental Stations at Santa Monica and Chico, will show.

The posting of "Fire Notices," and the publicity given to the reward offered for evidence against depredators as fire-setters, have also been productive of a great saving to the people.

FINANCIAL STATEMENT.

Appropriation, 1889–1890		$30,000 00
Salary Head Forester	$3,150 00	
Traveling, etc., Head Forester	1,327 47	
Salary Forestry agents, posting notices, etc.	5,658 60	
Expenses of experimental stations	3,301 95	
Wages and incidentals, plantation employés	6,692 38	
Salary, Secretary	2,625 00	
Contingent expenses, Secretary	46 20	
Salary, Botanist	600 00	
Contingent expenses, Botanist	168 65	
Traveling and incidentals of Commissioners	308 98	
Seeds, trees, etc., distributed	564 71	
Stationery, porter, postage, printing, etc., main office	400 65	
Rent, furniture, fuel, etc.	1,431 00	
Insurance and legal expenses	39 00	
		26,314 59
Balance to credit of Board		$3,685 41

It should be borne in mind that three months are yet to intervene between the date of the above statement and the expiration of the time in which the last appropriation has to run. The balance shown it is thought will barely suffice to pay the necessary expenses of the Board, the care and cultivation of the plantations already set out and growing, the expense of illustrating by artotypes the present report, the sending of the same through the mails, the traveling expenses of the Commissioners and officers, and the necessary incidental expenses of the main office.

Respectfully,

SANDS W. FORMAN,
Secretary.

JANUARY 1, 1890.

REPORTS OF W. S. LYON, FORESTER.

Office and Experimental Grounds at Santa Monica.

PART I.

REPORT ON THE CONDITION OF THE EXPERIMENTAL STATION AT SANTA MONICA.

The grounds at this station have been subdivided into three sections: One is exclusively reserved for the rearing of young forest tree seedlings; a second space is alloted to the individual planting of different species, with a view to the ultimate development of each to its uttermost capacity of either ornament or economic value; the third portion for the making of practical forest plantations *en bloc*, and of growing these latter under different systems of treatment.

The methods followed in the nursery are those generally pursued in California—a large proportion of the trees being reared in pots and boxes, a custom not generally prevalent in Eastern or European forest nurseries.

This method offers less root disturbance than is encountered in the nursery row system, and admits of prolonged planting into the heats of summer, which in our country of intermittent rainfalls would not be practicable under the open nursery row plan, except by recourse to the costly and tedious operation of removing and sacking each plant with a considerable ball of soil.

Aside from the trees needed for our own requirements in making the forest plantations referred to, a very large number are being grown for general distribution. The intention in making this distribution is, that parties applying for, and receiving trees from the Board, shall within one year thereafter render in writing to us a brief report setting forth the measure of success that has attended the planting; the character of the land where planted, the amount of cultivation, or water, or both, that has been given, or if none; and to report the growth made by each species sent during the current season under these different conditions.

As it is improbable that our stations can ever be located in all parts of this State, and as an auxiliary to our work in determining varieties best adapted to diverse soils and climates, we expect by this means to extend our operations over a very large area, and to interest each recipient in becoming a close and independent investigator. This plan has already been the means of furnishing reliable information from many points in the State, and though records so obtained may lack the value of reports from trained observers, yet when properly sifted and collated become valuable coefficients to our general work and furnish reasonable data upon which to base future operations.

It has been our policy to send out a limited number of individuals, and as great a variety of species as the condition of our supply and the as far as known nature of the district where sending would admit of.

As a rule, the number sent out to one person is limited to fifty plants, deviations from this only occurring where the shipments were made to distant points or remote from railroad facilities, and the costs and risks

of transportation so great that an added number have been sent to cover these extra risks and expenses.

Exceptions have also been made in interest of Boards of Education and School Trustees, who have desired to plant shade trees upon school grounds, and who had no fund upon which they could draw for the purchase of them through ordinary channels. Besides these, various State eleemosynary institutions, and town or municipal parks have been supplied; but by far the most extended of our distributions have been among village improvement associations, or to farmers' clubs for the planting of highways, avenues, and country roads—an object in itself only less commendable in small degree than the planting of permanent forests.

In addition to this, during the past two years we have sent out small collections to four hundred and twenty-one persons who have filed upon timber culture claims within this State, and who seemed to be wholly at sea as to the requirements of the Act and as to the trees they could plant with best results and least loss. As these parties have now, or will have, ample time to test the value and success of the varieties sent out, their labors become a valuable adjunct to our work, and must before their time expires result in the afforestation of a very considerable portion of our now treeless districts.

In many cases filings upon these lands have been speculative, with no intention on the part of the original locator to comply with the law; the forfeiture clause will sooner or later make them revert to the Government, while the experience derived through experimenters upon adjoining claims must result in marked benefit to the public, whether the forestation of the lapsed claims be undertaken in the future by State, national, or individual effort.

A number of applications have been received by us for trees sufficient to plant out an entire timber claim, and though anxious to facilitate in every way the operations of the tree planter, and to devise ways and means to overcome the many obstacles to the planting of waste lands, we cannot be expected to discriminate in the favor of any individual to such an extent as would leave us powerless to meet the requirements of future applicants.

This tree distribution has exercised a widespread influence for good throughout the State. It has stimulated individual planting to an extraordinary degree. Our recommendations have been the direct incentive to the actual planting of a great number of small tracts, from five to twenty acres, and not a few up to two hundred acres. Incidentally, this has imposed upon the Board a great mass of business far exceeding the narrow limits originally contemplated by growing and distributing a few trees haphazard. It now involves every detail of forestry in its widest significance; all the economic uses of trees, their values, costs, and profits; all of their possible ranges of soil and climate; their fitness, or otherwise, for a multitude of purposes under an infinite variety of conditions—have furnished the material for a mass of correspondence from all parts of the State, so far reaching and voluminous, that the enlargement of this report three hundred fold would not embrace it.

To illustrate the diversity of the subjects brought to our notice, and to show the willingness of the general public to conform to our request to furnish us with the reports needed to extend the field of our useful-

ness, we will embody with this report as an appendix, a very few letters bearing upon the problems we are called upon to solve.

That there need be anticipated no abatement of interest in all that pertains to tree planting, is evidenced by the fact that we have now on file more than three times as many applications for trees for the present season as we received last year.

We were never before so well arranged or supplied to meet these requisitions, and for that section of the State most readily accessible to the Santa Monica Station, are prepared to supply the wants of those desiring to make tests in different localities with the subjoined list and stock of young forest trees:

		Number Pot Grown.	Size of Pot—Inches.	Height of Plants (Nov. 1, 1890)—Inches.	Number Box Grown	Height Box Plants (Nov. 1, 1890)—Inches.	Total Each Species.
E. rostrata	Red Gum	611	2¼	8 to 15	22,600	4 to 10	23,211
E. viminalis	Manna Gum	120	2	6 to 8	15,150	10 to 14	15,270
E. corynocalyx	Sugar Gum	160	2	4 to 6	2,100	3 to 4	
E. corynocalyx	Sugar Gum	52	2¼	6 to 8	5,860	6 to 8	8,614
E. corynocalyx	Sugar Gum	42	4	10 to 12	400	2 to 3	
E. globulus	Blue Gum				2,200	2	
E. globulus	Blue Gum				3,860	8 to 12	6,060
E. diversicolor	"Karri" of S. W. Australia	210	2	6 to 12			
E. diversicolor	"Karri" of S. W. Australia	5	3	12 to 16			5,115
E. diversicolor	"Karri" of S. W. Australia				4,900	6 to 10	
E. leucoxylon (var.?)	Iron Bark				5,600	6 to 8	
E. leucoxylon (true)	Iron Bark	35	3	12 to 15			5,635
E. obliqua	Stringy Bark, messmate	99	2	6 to 8	90	6 to 8	
E. obliqua	Stringy Bark, messmate	31	3	10 to 12	3,288	10 to 12	3,508
E. polyanthema	Many-flowered Gum	37	2	667	3,100	8 to 10	3,137
E. goniocalyx	Bastard Box	240	2	4 to 8	1,108	10 to 14	1,348
E. paniculata	White Bark, N. S. W.				770	8 to 10	770
E. marginata	Jarrah	150	2	4 to 5			
E. marginata	Jarrah	460	2¼	6 to 8			661
E. marginata	Jarrah	51	3	8 to 12			
E. amygdalina	Giant Gum	47	2¼	6 to 8	382	8 to 10	
E. amygdalina (var.)	Giant Gum	22	3	15 to 18			451
E. Gunni	Swamp Gum	264	2	10 to 12	78	12 to 14	342
E. colophylla	Handsome Leaf	22	3	8 to 12	300	4	322
E. Stuartiana	Apple-scented Gum	247	2¼	10 to 16			247
E. pilularis	Black Butt	31	2	6 to 7	165	10 to 14	196
E. piperita	White Stringy Bark, N. S. W.	158	2	6 to 8			158
E. amygdalina (var. regnans)		56	2	4 to 6	80	6 to 8	136
E. obliqua (var. fissilis)		122	2	5 to 7			122
E. punctata	Leatherjacket, N. S. W.	106	2	8 to 12			106
E. siderophloia	White Iron Bark				90	4 to 6	90
E. botryoides	Bastard Mahogany				70	4 to 6	70
E. melliodora	Yellow Box, Victoria	22	2¼	12 to 16			22
E. platypus		17	3	16 to 18			17
E. stricta		10	2¼	6 to 8			10
E. Preissianum		4	2	4			4
E. Lehmanni		4	2	5			4
E. corymbosa	Bloodwood, N. S. W.	3	2	6			3

E. saligna	Flooded Gum, N. S. W.	2	2	6			2
E. citriodora	Sweet-scented Gum	2	2	4			2
E. ficifolia	Fig-leaved Gum	1	2	4			1
E. alpina		1	2	3			1
E. (?)	Unknown Species	12	2	6 to 8			12
E. tetraptera		4	2½	8			4
E. eugenioides	Eugenia-like Gum	1	3	10			1
Total							75,647

								Total Each Species.
								6,068
								18,551
								5,002
								2,181
								840
								260
								228
								182
								153
								62
								61
								61
[illegible]	[illegible]			[illegible]	[illegible]			7,800
...sis	Guadalupe Cypress			2,720	6 to 8			2,720
[illegible]	Monterey Cypress			2,054	10 to 12	11	12 to 16	2,065
Chamœcyparis Lawsoniana	Lawson Cypress	315	16 to 20			32	12 to 15	347
Larix Europœa	Larch, European	152	4 to 10					
Larix Americana	Larch, American					2	10	2
Sequoia sempervirens	Redwood					108	10 to 20	108
Sequoia gigantea	Big Tree	40	4 to 6			3	6	48
Abies concolor	Balsam Fir	23	4					
Casuarina quadrivalvis	She-oak			430	8 to 12	615	10 to 20	1,045
Pittosporum undulatum		91	10 to 12	2,285	8 to 10	31	8 to 10	2,407
Robinia pseudacacia	Black Locust	1,964	15 to 20					1,064
Lagunaria Pattersoni		96	10 to 12	1,310	8 to 10	205	7 to 8	1,611
Quercus pedunculata	English Oak	1,404	10 to 16					1,404
Quercus agrifolia	Encino					17	6 to 8	17
Catalpa speciosa	Catalpa	1,806	2 to 3 ft.					1,806
Catalpa Kœmpferi	Catalpa Kœmpfers	88	2 to 3 ft.					88
Sterculia deversifolia				420	4 to 6	270	4 to 6	690
Sterculia acerifolia	Flame tree					4	15 to 18	4
Juglans nigra	Black Walnut	119	2 to 3 ft.					119
Juglans rupestris	California Walnut	361	2 to 3 ft.					361
Juglans (?)	Japan Walnut	16	2 to 3 ft.					16
Melia Azedarach	Umbrella tree	67	1½ to 2 ft.					66
Carya sulcata	Western Hickory	71	6 to 8					71
Carya alba		18	4 to 6					18
Carya olivœformis		17	6 to 8					17
Acer macrophylla		73	5 to 6 ft.					73

Zelkowa Keaki	Elm (Japan)	119	3 to 5 ft.			24	24	143
Prunus illicifolia	California Cherry					76	4 to 8	76
Santalum Pressianum	Quondong					12	6 to 8	12
Acacia acanthoptera						47	4 to 5	47
Acacia falcata						63	4 to 6	63
Acacia retinoides						52	3 to 4	52
Acacia armata				1,200	6 to 8	315	8 to 10	1,515
Acacia obliqua				200	4 to 6			200
Acacia decurrens	Black Wattle					6,090	4 to 10	6,090
Acacia melanoxylon	Blackwood					3,996	5 to 10	3,996
Acacia pycnantha	Golden Wattle					853	3 to 6	853
Albizzia lophantha	Bastard Acacia					1,510	12 to 18	1,510
Pithecolobium pruenosum						190	10 to 12	190

RECAPITULATION.

Eucalyptus	75,647
Conifers	49,095
Acacias, and allies	14,516
Miscellaneous	10,403
Total available stock	149,661

In addition hereto, we have about twenty-five thousand seedlings that will require another season's growth to bring to the most suitable condition for general planting. They comprise chiefly, *Pinus Masoniana*, *P. pyrenaica*, *P. Parryi*, *P. Thunbergi*, and *P. inop; Abies Mertensiana*, *Thuya gigantea*, *Cedrus Deodara*, *Fraxinus Oregana*, and *F. dipetela*, var. *trifoliata*.

Our second subdivision, as already stated, has been reserved for the isolated plantation of individual specimens, sufficient space being allotted and duplicates planted to permit of the future development of each, and to admit of cutting in order to yield a supply of material at hand from which to make careful timber, fuel, or other economic determinations. We have now above two hundred species there represented, and when it is borne in mind that the total number of forest trees of the United States falls below five hundred species, are satisfied that the showing now made is creditable for an institution still in its infancy.

Many of the exotic species introduced into gardens, grounds, or parks in this State have had no opportunity, either from want of space or a want of knowledge of their requirements, to exhibit their fullest growth and best development; we aim to obviate these defects upon the station grounds, and to combine with an arboretum for our own uses an opportunity for the public and those interested in forestry, sylviculture, or ornamental planting to determine for themselves the ultimate appearance of these species, to the end that their own planting may be conducted with both intelligence and success.

Our strict forest plantations have so far been carried on to the determination of requirements of cultivation rather than exhibiting the value of species; concurrently much valuable information will be derived upon this point. Our system contemplates planting with the same species three tracts of land. Upon one the trees are set without regard to clearing brush, weeds, or other obstacles to growth; these trees receiving neither water, cultivation, nor any previous preparation of the soil. A second subdivision receives, where possible, preparation of the land and some subsequent cultivation. The third receives both cultivation and irrigation. These experiments were only inaugurated last winter, and it is yet too early to predicate results. With the first method, as was to be anticipated, we have scored a large percentage of failures; enough, however, have survived the ordeal of one summer to justify us in continuing the experiment still further. If results finally attained demonstrate that a reasonable measure of success attends the planting of *any* forest tree in California under such conditions, a great stride will have been taken in the direction of ascertaining if our barren hills may be converted to any profitable uses, or at least to uses not involving a great outlay of capital and labor before they be made productive. It is a question of secondary importance in other countries, or at least in countries visited by frequent and copious rainfalls, and where the character of the soil and timber to be grown thereon become the prime factors in every operation of forestry. In this country the adequacy of the rainfall must at all times be the leading consideration, and as results attained by these experiments will indicate what may be expected to follow over a very great part of the State, we do not hesitate to pronounce these comparative tests now in operation to be one of the most valuable practical experiments that can be undertaken, and promising within a few years to yield more definite results than any and all others that could be devised.

Nursery Grounds near Santa Monica.

PART II.

SOME NOTES ON THE GENUS EUCALYPTUS.

As will be seen in the foregoing list, our collection of eucalyptus still takes numerical precedence over all others.

The reasons for this are obvious and many, nor is it necessary to enter into an exhaustive dissertation upon the comparative merits of the eucalyptus family for timber purposes with our own native or other exotic woods to account for this.

Leaving aside all other considerations, for unparalleled rapidity of growth the genus, with a few exceptional species, still stands preëminent as the quickest grower ever introduced into the State, and the facility and rapidity with which treeless areas can be converted into forests by its use must tend to enlarge its planting, perhaps to the discouragement of the planting of more valuable woods.

Until quite recently the name eucalyptus, or rather its use in California, was exclusively used to cover a single species, the common Tasmanian Blue Gum, and though it is now many years since the introduction of other species, the Blue Gum, by virtue of the wide publicity given to its merits, has continued far in the lead over all other species planted, and to-day still constitutes quite 95 per cent of all the eucalyptus plantations made.

A great impetus was originally given to the planting of Blue Gums along the lines of our railways by reason of its reputed value for railway ties;* its continued growth and use for this purpose in Algiers and in the Australian Colonies, and in parts of the world with climatic conditions not dissimilar to our own,† and by the well known fact that if adapted to this purpose that the thousands of miles of railroad running through the treeless regions of the west and southwest would furnish a market for all the ties that could be grown for many years to come, had stimulated this planting to an exceptional degree.

Its reputed durability was about nine years as against only seven to eight years for the White Oak, and only the same period for our average redwood tie,‡ and with the enormous annual consumption of six and one third millions upon this coast, it is no matter for wonderment that

* South Australia Forest Reports, 1887-88, p. 9.

† "Extra Tropical Plants," von Mueller, p. 132.

‡ Mr. B. E. Fernow, in an admirable and exhaustive treatise upon this subject modestly published as "Forestry Bulletin, No. 4 of the United States Department of Agriculture," gives the average life of a redwood tie as eleven to twelve years. This has reference only to its resistance to decay. For railroad purposes over main lines and when subject to heavy traffic, they, by reason of deep cutting, become unserviceable in from seven to eight years. This practically fixes their duration of life for railroad uses. Decay not being the only factor determining their longevity—a tie set in 1856, and taken out this year, after thirty-four years being found absolutely free from decay. For this information I am indebted to Mr. J. H. Wallace, Assistant Superintendent of Track of the Southern Pacific system, from whose instructive report on eucalyptus ties I shall make further quotations.

the planting of this tree should have been prosecuted to an extraordinary degree.

The experiments conducted by the Southern Pacific Company with eucalyptus (Blue Gum) ties at Rose Creek, Nevada, between the years 1877 and 1888, show that their resistance to decay only endures about seven years, while their susceptibility to checking and cracking makes them practically unsuitable for this purpose. Great difficulty was experienced on this account of keeping the rails properly spiked down. "Some few of these ties remained for eleven years, but under ordinary circumstances would have been removed several years sooner than they were, the object of leaving them in so long was to ascertain only what their life would be with reference to decay." *

The unfortunate experience of the railroad company with regard to the durability of this wood seems to find ample corroboration by the observations of those who have grown it extensively for fuel, and who uniformly accredit with speedy decay the lowest tiers of cordwood.

Despite these adverse results, we can hardly accept them as final, and have now in hand experiments under way which, when perfected, will demonstrate if the tendency of the wood to check and crack, and its liability to decay, are not adventitious properties readily controlled by harvesting at the proper season of the year, or by proper curing, or by both.

We are amply justified in following up tests with this wood to the uttermost possible limit; rarely can the case be cited of the introduction of any exotic throughout the extra-tropical latitudes of the world which has resulted so successfully and has accommodated itself to such varying conditions as that of the Blue Gum.

We know of its successful introduction into South Australia, where it has to endure worse extremes of climate than subjected to here;† and its value for forest uses, where its treatment is fully understood, is most strongly attested by the fact that so late as 1887 it constituted 20 per cent of all the trees planted by the forest administration of that colony, and in numbers planted was only exceeded by the Sugar Gum.‡

In our own State it exhibits a ready adaptability to nearly all soils and localities where the mercury does not fall below 22 to 24 degrees Fahrenheit, and may be considered fairly naturalized, seeding freely, and reported as now reproducing itself spontaneously in several sections of the State.

Entirely independent of the results obtained by our experimental timber tests upon this wood, the planting of Blue Gums must continue for years to come to occupy a prominent place among our active industries. It still holds the lead in popularity as a quick and effective means of producing abundant though inferior fuel, while local industries, dependent upon its growth, are being established in the State. For some years a manufactory in Alameda has been profitably engaged in the production of an extract of crude oil inimical to the formation of incrustations in boilers.

More recently, still another in Los Angeles is engaged in the distillation of the refined oil of eucalyptus. Their efforts have been attended

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* Letter from Mr. J. H. Wallace, October 3, 1890.

† Report of Progress and Condition of South Australia Botanic Gardens, 1887-88-89, by Dr. R. Schomburgk.

‡ Forest Reports of South Australia, 1888, by J. Ednie Brown.

with flattering success, their product being declared equal to the very best European article. The well known antiseptic qualities of this oil, together with its non-irritant character, is causing it to largely supplant the mineral disinfectants heretofore used in such vast quantities. The annual importation of this oil by the United States amounts now to not less than fifteen thousand pounds per annum, all of which may, in all probablility, be produced in a short time within our borders.

Many side products, including aerated waters charged with its extracts, are coming into general use, and in view of its continued propagation by the nurserymen of the southern half of the State in the ratio of one hundred to one of any other species of forest tree grown, it is fair to assume it will maintain its supremacy and deserved popularity as an "all around utility" tree for many years to come.

It will be noticed by consulting the list heretofore given, that of thirty-six species of eucalyptus grown this season at Santa Monica Station for distribution, and our own planting, that less than one third the number of species embrace more than 90 per cent of the individuals reared. This selection, or preponderance, in favor of a few varieties, is due primarily: First, to the greater reputed merits of the favored species as gathered from reports and records of organized Forest Boards elsewhere; secondly, to the success had by individual planters over a wide and diversified area of the State.

Our own experiments, extending over less than three years, are still in their infancy, and though instructive, must necessarily as yet be only of corroborative value to results had over a longer period of time.

All, or nearly all of the species here enumerated, have been grown by Mr. Ellwood Cooper, of Santa Barbara, and nearly all are reported to us from the State University, and a number of the same from other points where they have been grown as objects of ornament or curiosity.

In all cases special care or cultivation has been given, or fertile and favorable locations had, which has resulted in the growth of superior specimens, but which has established nothing whatsoever in determining the forest or other economic value of these many claimants to our favor, our knowledge of which for forestry purposes is still an unknown quantity.

With the system now observed in our tree distribution, it is confidently believed that with the data thereby obtained, we can, within a few years, unerringly indicate to every tree planter in every quarter of the State the trees he should plant to yield him the most unequivocal returns for the time and capital invested.

Careful collation of such material as is obtained by us daily in letters like that of Mr. Price,* when supplemented by our own trial tests, we believe will give an assurance of confidence to tree planters that must stimulate the making of forest in a superlative degree.

Fully one half of all our eucalyptus consist of the Red Gum referred to in this letter, and the Manna Gum, respectively, *Eucalyptus rostrata* and *Eucalyptus viminalis*. Neither of these species fall within the list of so called alpine sorts enumerated by von Mueller. †

But our correspondence seems to indicate their stronger heat and cold resistant power than any of the species heretofore introduced.

At Alpine, Lancaster, Rosamond, Palmdale, Mojave, and Keene, in

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* See appendix for letter.
† "Extra Tropical Plants," p. 134.

Los Angeles and in Kern Counties, snow not infrequently occurs and low temperatures prevail every winter.

To all of these points trees have been sent, with the weight of testimony to the effect that these two species have given the best satisfaction and shown the most endurance.*

From Dehesa, Perris, Jamul, San Jacinto, and other San Diego County points where mountain plantings have been made at elevations within the range of occasional snows, reports corroborative of the above have been uniformly received.

Throughout the length of the San Joaquin Valley, the Blue Gum is not rarely winter-killed, and its possible northern limit may approximately be located at Sacramento.

Two years ago, large trees of this species succumbed to frost at points in Calaveras, Stanislaus, Merced, Tulare, and Fresno Counties, where young plants of the Red and Manna Gums were uninjured.

Last winter (1889–90) our own young plantations of these two kinds at Chico, Butte County, were unaffected, although they endured for four consecutive days a temperature of 24 degrees Fahrenheit, and as well have made satisfactory growth under stress of the long continued high summer temperature of the upper Sacramento Valley.†

From Hesperia, Indio, Salton, and points upon the so called "desert" of San Bernardino and San Diego Counties, where the greatest summer heats prevail, and whither we have sent trees, reports as yet are too conflicting upon which to predicate reliable information.

In the matter of resisting drought, the comparative merits of the Red, Manna, and Blue Gums, as determined by our own experiments upon dry, uncultivated hillsides at Santa Monica, show them to be nearly even, the Manna Gum scoring a few points in advance of the others.

The equable climate that prevails here throughout the year gives us no opportunity of testing the behavior of these trees under extremes of temperature; but in the very important matter of determining their action under prolonged drought, our observations can be carried out to final and correct conclusions.

That the Manna Gum should prove satisfactory upon this point, is but in harmony with its reputed success in Quorn, South Australia,‡ where it survives more difficult conditions than any quoted in our report.

The capacity of the Red Gum to endure arid situations, as shown by our correspondence and our own trials, is somewhat perplexing.

From its local history, its successful growth could only be anticipated upon low lands, or moist river bottoms. Such it naturally affects in the Colonies, even to lands periodically inundated; and its promise of success here upon dry exposures is in the nature of a pleasant surprise.

The wood is reputed to be greatly more durable underground than the Blue Gum, and to have superseded generally all other native timbers in Victoria for railway construction, ties, etc.

From a timber standpoint there is little doubt of its complete superiority to either the Blue or the Manna Gum; and even if future tests should result adversely to its adaptability for railway uses in this

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* The summer temperature at these points sometimes reaches the excessive heat of 108 to 110 degrees Fahrenheit, accompanied by high, drying winds. See letters in appendix.

† It should be mentioned that the "Stringy Bark" (*Eucalyptus obliqua*) withstood this test as well.

‡ S. Australian Forest Reports.

country, its undoubtedly greater fuel value than the Blue Gum should be an incentive to its more general planting.

Explanatory of our rearing these two species in excess of all others has led us to dwell upon claims to their excellence largely known to the general public. Our justification lies in the fact that at the present time, and with present knowledge, they offer greater promise of general success under diversified conditions than any yet sent out.

Of other species now growing here, we will only allude to those which within a brief time have developed some especial merit commendatory of their general use.

EUCALYPTUS CORYNOCALYX (SUGAR GUM).

This tree, during the three years since it was first disseminated by the Board, has come into exceptional favor, emphasized by almost daily inquiries addressed to us for information in obtaining the seeds or plants in large quantities.

We unhesitatingly pronounce it to be by far the most satisfactory eucalyptus yet introduced for street, avenue, or sidewalk planting within the thermal districts of the State.

An inflexible scale of excellence, by points, of trees designed for these purposes cannot be formulated for all places. The *points* cannot be disputed; their *sequence* may vary with the conditions and requirements exacted by different localities.

For the section of the State mentioned, we suggest the following arrangement:

1. Umbrageousness.
2. Hardihood (as to drought, not extremes of heat or cold).
3. Strength to resist high winds.
4. Rapidity of growth.
5. Freedom from insect pests.
6. Ornamental beauty.
7. Longevity.
8. Freedom from litter, or continuous leaf dropping.

To these might be added, as an important factor, immunity from the attacks of rodents, but as this is a consideration largely under our control it should not affect the rating or standing of a roadside tree.

The Sugar Gum takes a high rank in all these essential points. At five years of age we have seen trees still under forty feet in height with a natural crown diameter fully as great; an uncommon feature of the genus, as all know who have continuously and laboriously "cut back" other species in the attempt to promote a lateral growth.

Its restriction to a limited zone is predicated by reports reaching us of its yielding to slight frosts. Careful inquiry into the alleged causes of failure from this source has elicited the information that copious irrigation, succeeded by an autumn of unusual heat, had stimulated a luxuriant growth of rank and tender foliage that was summarily blasted by a quickly intervening frost.

Other credible observers report its being killed (when young) by an exposure to 28 degrees Fahrenheit, where such precocious growth did not obtain.

This brings us again somewhat in conflict with Australian reports,

which uniformly ascribe to it a considerable amount of endurance against both heat and cold.

Mr. West, an agent of the Victorian Government, and recent visitor to this coast, says that the planting of this species for *all* purposes is making great strides, and is largely superseding the planting of most other species.

This statement is strongly corroborated by Mr. J. Ednie Brown in his reports, wherein it is seen that nearly 35 per cent of all the trees planted in the various forest reserves of the department in South Australia during 1888 and 1889 were this species.

Of two hundred and thirty-six thousand trees gratuitously sent out by the same department during that season, one hundred and nine thousand were of this sort; and as evidence that it is in no way falling into disfavor, we may state that 45 per cent of the trees now being reared in the department nurseries continue to be Sugar Gums.

Here in California many planters enthusiastic over its beauty will plant largely the approaching season, and before many years we will be able to define sharply its possible limitations for this coast.

EUCALYPTUS DIVERSICOLOR (THE "KARRI").

Another of the denser foliaged species; pronouncedly of more rapid growth than the Sugar Gum, and the subject of many favorable reports to us upon dry situations.

This is one of the giant gums sparingly introduced by growers into this State under the name of *Eucalyptus colossea.*

EUCALYPTUS MARGINATA (THE "JARRAH")

Is handicapped by the general verdict of "slow growth," and as well seems to require a liberal amount of moisture. Trees of considerable size are flourishing in the favorable locality of Berkeley, while in that exceptionally favored spot, Cahuenga, Los Angeles County, exist a few trees quite six years old. None of these yet exceed thirty feet in height or have a largest stem diameter of over seven inches. Information confirming its slow growth are received from many quarters, and ranging from Alameda to San Diego County.

Our distribution of seeds and plants of this species last year was extended over a large area, in the hope of discovering some congenial locality where its growth might be commensurate with that of some other species. If there be any section of our State where this tree will come to early maturity, or to a size sufficiently large to convert its timber into piling, there seems to be no reasonable doubt but that it would yield the most valuable forest crop that could be grown. With all our wealth of serviceable native Pacific species, we have nothing adapted to this purpose until it has been subjected to the costly, and even then insufficient process of creosoting.

The "Jarrah" enjoys absolute immunity from the attacks of marine borers and is practically indestructible, and, if it can be grown here, a ready home market for wharf or jetty purposes is assured for every stick raised. In view of these merits, we shall continue its further distribution, limiting its issue, if possible, to localities abounding in ferruginous

soils, as upon such, in its native habitat, it attains its most rapid and perfect development.

EUCALYPTUS GUNNI (WHITE SWAMP GUM).

Under this name we are now growing the species described in Bulletin No. 6 of this report as *Eucalyptus polyanthema*. Flowering or fruiting specimens of this species not existing as yet in the State, we shall only issue it under a ?, awaiting future opportunity to confirm the nomenclature.

Except for the interesting contrast it presents to the "Jarrah," it would be passed over to await complete identification. Its phenomenal growth demands more than passing notice. In our own plantation a number of individuals exceed thirty feet, and one has attained to thirty-four feet and a stem diameter of seven and one half inches within twenty months of the time of planting.

This result is unparalleled, and I have searched in vain for authentic reports of a similar tree growth ever occurring under like or any other conditions.* During this time the growth made by a Tasmanian Blue Gum, standing within one hundred and fifty feet of this "swamp gum," is less than eighteen feet.

OTHER VARIETIES.

Of other varieties upon our list which arrest attention is *Eucalyptus calophylla*, striking in view of its handsome foliage and rather showy panicles of pure white flowers; it is the close congenor of the Scarlet-flowered Gum (*Eucalyptus ficifolia*), both now widely dispersed in Southern California and flowering freely in many places.

Eucalyptus calophylla is held in good esteem for timber, the wood being light but very strong.

The young plants of *Eucalyptus platypus*, *E. pilularis*, *E. Stuartiana*, *E. eugenioides*, *E. stricta*, and others, exhibit considerable ornamental value, but in view of the remarkable leaf modifications which most species undergo with age, it is unwise at this stage of our knowledge to assume that these now attractive qualities shall be enduring. In view of the important part which this genus promises to play in the future afforestation of this State, much space has been accorded to its consideration; but that the Board recognizes that it cannot fill all requirements, and that other trees must occupy a prominent place in the general forest economy of the State, is shown by the second list now in reserve for planting at and distribution from Santa Monica Station.

Brief mention will be accorded some of these other genera and species, while more extended monographs will follow those showing special adaptability to our State, and whose economic merits are so great as to justify close investigation.

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* For conditions, see Forestry Bulletin No. 6.

PART III.

THE "CLUSTER PINE" IN CALIFORNIA.

PINUS PINASTER—"CLUSTER PINE," "MARITIME PINE."

This tree is so easily reared, so readily transplanted, the seed so inexpensive, and its successful growth so independent of expert management, and withal, so amenable to all treatment and all situations, that we have entered upon its propagation to a considerable extent. Small specimens were planted upon the south (hot) side of a bluff during April, 1888, and have had neither care nor other water than rainfall since; over 90 per cent have grown, and are now sturdy, stocky trees of five to seven feet in height.

The bluff is so nearly perpendicular that excavations the height of the young plants had to be made to admit of setting them in a vertical position. The experiment was made primarily to determine the vitality of the species under hardship; incidentally, to test its value as a restraint to landslides.

During the excessive rainfalls of the winter 1889–90, these young pines were not washed out, but neighboring hills covered with a puny growth of Audibertia species, Rhus, and Adenostoma were badly gullied and washed. The native "brush," while a conceded and valuable auxiliary to this work, is unreliable, lacking size, strength, and root depth enough to prevent or arrest when started the momentum of a landslide.

A good illustration of this exists at Arrowhead Hot Springs, San Bernardino County, where the Arrowhead (the denuded area) is, after seasons of heavy rainfall, most sharply defined. When two or three seasons of scanty precipitation occur, the native brush growth reasserts itself, and the vast scar upon the hillside becomes almost obliterated.

It is not contended that the Cluster Pine is the only tree that would accomplish its rehabilitation; any equally rapid growing and of equal hardihood would accomplish the same purpose, provided the season of planting out was not one of excessive rainfall; but rapidity of growth is an indispensable condition.

Pinus tuberculata, the Tubercled Pine, is indigenous within a few miles of Arrowhead, but of such exceptionally sluggish growth that it would never accomplish the results that could be achieved with the Cluster Pine, and with one heavy winter would fare no better than the periodically swept away remaining native growth.

As this Arrowhead is an attractive objective point to the curiosity seeker, its forestation will hardly ever be attempted.

Attaching the importance which we do to the quick-growing, deep-rooting properties of plants suitable for this purpose, it may be asked why we single out the Cluster Pine to the apparent exclusion of other species.

So far, we have found a preponderance of points in its favor. During the past season we have grown *Pinus pinea* (Stone Pine), *Pinus insignis* (Monterey Pine), *Pinus Canariensis* (Canary Pine), and *Pinus Sabiniana* (Digger Pine), upon a site closely approaching the conditions existing where the Cluster Pines are planted. All the species named are quick of growth, but the percentage of loss in all has been greater than in the case of the Cluster Pine.

The *P. Canariensis* proved a failure; the Stone Pine displays strong vitality, but has made but little growth; the same is true of the Digger Pine, the Monterey Pine being the only remaining one that has done well and slightly outgrown the Cluster Pine in size, but at the loss through drought of a greater number of individuals.

This pine, the Monterey, has long been considered unique amongst the Coniferæ for its unrivaled celerity, and has (presumably on this account) been widely diffused abroad, meeting with great favor and being in great demand in the Australian colonies.

In California, remote from the seacoast, cultivated specimens at ten years only slightly exceed the growth made by the Cluster Pine, but near the coast the Monterey generally exceeds it greatly in growth made in the same time. A single exception exists perhaps where they are planted in rolling sands—such as exist in the Golden Gate Park—where, as I am informed by the Superintendent, Mr. McLaren, the growth of both species is about uniform.

Well grown specimens of the Cluster Pine, as far inland as Oroville, give assurance that the lower foothills of the Sierra Nevada Mountains below the timber line would furnish a congenial home for this invaluable tree along the whole distance of the San Joaquin and Sacramento Valleys. Practically, with all our timber riches, we have no coniferous or other tree native to this coast, which furnishes a supply of naval stores.

The only tree we know of that greatly excels the Cluster Pine in its yield of tar, resin, and turpentine is the Georgia Pitch Pine (*P. palustris*), and which not only is reported to take fifty years to reach the maturity which the Cluster Pine attains in twenty to twenty-five, but judging from the inferior and stunted appearance of the few of the former we have seen upon this coast, no great inducement can be offered for its planting.

From official correspondence we learn that the estimated area planted to the Cluster Pine in the Departments of the Landis and Gironde alone, in France, during 1888–9, amounted to twenty-one thousand hectares (nearly fifty thousand acres). Originally only planted with a view to reclaiming the sand wastes that align the bay of Biscay, it has proven so profitable a crop that of late years its cultivation has extended over better lands; enough of its products now being yielded annually to make the republic almost independent of foreign supplies of turpentine, tar, resin, and charcoal. After the tree is exhausted by constant tappings for its oils, it is felled and converted into a superior article of charcoal, which furnishes one of the chief fuel supplies of the people.

England, who annually pays us $3,000,000 for naval stores, some years ago, influenced by the pronounced success of these plantations, attempted similar operations in Devonshire, upon the south coast, and though the trees have thrived, the humidity and summer coolness has seriously acted to prevent the formation and yield of the precious fluids.

No such objections can possibly exist in California. We cannot learn of any tests having been made in this State to determine the freedom and quantity of sap flow in the summer months, but it is almost impossible to surmise that results upon this score should be other than the best.

Upon this coast we are entirely dependent for all these supplies so largely used in many arts and manufactures exclusively upon the eastern markets. Their consumption is enormous, and that of turpentine and resin constantly increasing, and their production here not only implies profitable returns to the producer, but indirectly great prosperity to the State in retaining at home wealth that otherwise must go abroad.

We have named the *Pinus insignis* in connection with this as the only species tested here comparable in the matter of early maturity with others, but is lacking completely in all the economic properties that make this so valuable.

From a timber standpoint neither take a high rank, and the planting of pine trees exclusively for timber uses, unless undertaken by the Government, will not universally find favor with the public—at least until the American idea has been modified in regard to these things.

The Scotch and Weymouth Pines take from seventy to one hundred and thirty years of growth to become serviceable for timber, and most of the California species of natural growth much longer; from careful countings had during the past summer over some of the most closely cut districts in this State, I find that the smallest trees cut of *Pinus Lambertiana* and *P. ponderosa* will chiefly show more than one hundred and fifty annual growths, and the general average approach about two hundred.

In countries where the laws of entail exist this is considered no deterrent, but probably under our institutions and our national haste will forever defeat the extensive planting by individuals of such slow maturing crops.

In France, twenty-five years is the extreme of time allowed to bring the Cluster Pine to maturity. From the remarkable growth made in this State in fourteen years (thirty-five to forty feet), it may reasonably be expected that they will attain complete maturity many years earlier.

At our northern station, young plants of Chamæcyparis, Torreya, and other hyperborean conifers "sunburn" somewhat during the prolonged summer heats; this phenomenon is not observed with the Cluster Pine, which has without protection made more thrifty growth than in the cooler, more humid atmosphere of the Santa Monica Station.

Its assured success there, and at the few points observed along the Sierras, impresses one with the certainty that the endless and now unproductive wastes of the northern Sacramento Valley foothills might quickly be converted to assured wealth-producing uses.

The extreme aridity of most of these hills, and except in a few favored districts, they having no immunity from sharp frosts, will operate for all time against their plantation with eucalyptus or probably wattles, while aside from the objections already noted against the planting of timber-yielding pines, the altitude is not great enough for our native ones at least to come to perfection.

These hills below the well defined timber line are chiefly covered with

a scrub growth of *Pinus Sabiniana*, *Arctostaphylos*, *Ceanothus*, *Rhus*, and other native "chaparral."

Except as a forest cover, this growth serves no appreciable purpose; the few inroads that have been made into it in the vicinity of mining camps for fuel are insignificant; the northern valleys are abundantly supplied with superior White Oak fuel, and it is most improbable that any increment to the valley population, however great, will create the drain on these foothill resources for fuel that exists in the southern end of the State.

Should the future bring forth an unanticipated demand for this fuel, by the time such arises, plantations of this pine will be in condition, after yielding its especial products, to furnish of its residue a fuel equivalent in value to most of the scrub now indigenous there. Several land owners have agreed to make plantations in this region for us during the coming winter, and we will be glad to coöperate with all others desiring to make a test of this tree so amenable to harsh conditions and unskillful treatment.

It carries well, and during the winter season with roots properly "puddled" may be transported long distances without soil, and consequently a minimum of weight. We therefore bespeak for it a very general trial.

PART IV.

WATTLES, AND WATTLE PLANTING IN CALIFORNIA.

For general purposes, the limits which define the successful growth of the Blue Gum in this State cover the area upon which we may hope for good returns with most of the wattles.

One of the hardiest acacias known, the *A. melanoxylon* ("Blackwood"), stood uninjured for twelve years in the grounds of General Bidwell, at Chico, but was killed to the ground in the winter, I think, of 1887–88; it then measured sixteen inches through the stem near the ground.

Trees of the same species the same year were uninjured at Sacramento, but the many dead limbs in the tops of the Black Wattles and its near allies, show that they did not escape unscathed. At Stockton they were uninjured, but at points farther south in the San Joaquin Valley, they were killed, where Blue Gums survived though severely injured; the shelter and continuously higher temperature that exists in towns and cities than in the adjacent open country accounting for the escape of the more northern examples.

Upon the peninsula of San Francisco and in the circumscribed area of the country surrounding the bay, most species come to great perfection, increasing in size and beauty as we retreat from the seaboard, until advancing farther north, east, and south, their development is checked by lower winter temperatures, not to again reach its maximum till we pass Point Concepcion on the south.

For many years, the public interested in such matters have been fully conversant with the economic value of many species of wattles; their ready adaptability to a large part of our State, and to a great variety of soils, has been almost as widely known. So long as twelve years ago the management of the University of California not only planted out freely upon their own grounds, but impressed with the utilitarian character of the trees made, and have at intervals continued to make, a very general distribution of their seeds.

Whatever of impetus to the planting of these trees might have been expected to flow from this, received a disastrous check with the introduction or appearance in this State of the white cottony cushion scale.

If not the original, they at least quickly became the favorite nidus of this virulent pest: originally confining their depredations to citrus trees, they soon spread to nearly all vegetation, and for a time impaired, and at one time fairly imperiled the vast horticultural interests of the State. The preference of this scale for acacias soon became freely known, and not only resulted in a discontinuance of their planting, but in the wholesale eradication and destruction of many promising young plantations.

Since that time the complete success attendant upon the introduction

of a parasite destructive to this pest which has proven its ability to at least keep it in check, if not to extirpate it, has removed the only barrier which now exists to the planting of wattles for pleasure or profit.

Pleasure is not one of the elements or factors upon which we expect to lay much stress in tree planting as a business operation, otherwise than in the ornamentation of grounds, parks, drives, etc.; but if the sensation ever occur, or be anticipated, or result even to the most practical, it will surely flow where the practice has to do with most of the wattles.

All of the broad-leaved species are so gratefully umbrageous; all of the feather or pinnate-leaved sorts so indescribably graceful and picturesque; nearly all of such superlatively rapid growth—many so brilliant of flower and grateful of fragrance—that it is hard to speak of the family or of any operations attendant upon their rearing that shall eliminate all considerations of pleasure.

Of profit that results, we must be more conservative, less adjectival; but all indications seem to point unerringly to the fact that prompt and remunerative returns will accrue as the reward from groves of these trees.

The chief economic virtue they possess lies in their bark as a tanning material; and the same argument which was used to advocate their planting twelve years ago now applies, but with precisely redoubled force, since the price of native bark has in that time advanced from $7 and $8 to $14 and $16 per ton.

By "native bark" we refer to *Quercus densiflora* (the "Coast Chestnut Oak"), which practically supplies all the tanners' bark used upon this coast. Its excellence as a tanning material is undisputed, and has chiefly, without doubt, contributed to the excellence and enviable reputation which the heavy sole, harness, and trunk leathers of California manufacture enjoy.

The yield of tannic acid from this bark, and its availability, is very great—analyzing as high in bark of best grade as 16.7 per cent, and freely giving up in the vats an estimated percentage of 12 to 13 of tannin. Its continued use, to the exclusion of other barks of equal strength, would be assured except for the grave fact that its supply is fast approaching the vanishing point.

From interviews had with many leading tanners, we find a very general feeling of alarm over the steady enhancement in value and scanty supply of bark offered.

Great sums are invested in tanneries here, and it forms one of our chief industries; and if in the near future we are compelled to look to eastern markets to furnish this indispensable requirement of the trade, it can only result in a suspension of the business and removal of their plants from the State. So impressed are the tanners with the situation that confronts them, that they are prepared to gladly undertake expensive risks of time and hides to make practical working tests of any material that gives fair promise of being an available substitute for oak bark.

That the enhancement in the price of this article is not due to the action of any speculative trust or combination, but to a legitimate rise from the scarcity of the article, is vouched for by our own examination into the northern and southern tan oak regions.

Its natural habitat is the redwood country, and in many localities, even in the Santa Cruz district where the redwoods still stand intact, every available oak has been stripped.

Even in Humboldt, whence our greatest supply is now drawn, bark-cutters are compelled to invade places once considered impracticable and carry out the crop on pack animals, and trails have been laid through most precipitous country to get at this precious product.

Some of the best oak lands remaining have been swept by fire, and, though this tree is remarkably tenacious of life, and revives from ordinary burnings, the bark becomes constricted and impaired in value, nor does it become fit for stripping for some years thereafter. These facts have led us to turn our attention to the wattles as offering the only possible means of averting the disastrous results of the bark famine which must overtake this State within a very few years. Complete returns of consumption we have been unable to secure, but have ascertained that thirty-one tanneries (less than one third in the State) consumed eighteen thousand tons in 1889, and the estimated annual consumption is now not far from fifty thousand tons, and the assurance of a continuous supply of this or any equally good substitute would stimulate the expansion instead of a decline of the industry dependent thereon.

Wattle growing as an industry has only of recent date been inaugurated, even in the Australian colonies. The native "bush," however, has for many years furnished the sole source of supply for local tanners, and their requirements, together with export demand to Great Britain, has seriously infringed upon the wild supply, and resulted in the adulteration of the bark with spurious or inferior sorts to an extent that has brought the product into disrepute, and caused lately the fullest inquiry into the whole subject by Mr. J. H. Maiden, F.L.S., of Sydney, New South Wales, from whose invaluable monograph * we shall quote such points as we think have a bearing upon the subject of their growth and commercial value in California.

Mr. Maiden, out of a list of over forty wattles or acacias that yield a greater or less amount of tannin extracts, finally cuts the list down to three species as giving the most promising returns for commercial uses. They are as follows:

Acacia pycnantha—South Australian Broad or Golden Wattle.
Acacia decurrens—Sydney Black Wattle.
Acacia mollissima—Tasmanian and Victorian Black Wattle.

There are other species whose merits, aside from their bark value, are so marked, that we shall briefly allude to them hereafter; but the three above named have been so extensively tried in different portions of the State, have proven so accommodating to varied conditions, and so far exceed all other species in their practical yield of both bark and tannic acid, that it is sufficient to recommend them for this purpose to the exclusion of all others.

In quantity of tannic acid yielded, the Broad-leaf or Golden Wattle is an easy first—a free average of many analyses amounting to 37 per cent, rarely falling below 32 per cent, and in exceptional instances the enormous yield of 46½ per cent, or nearly one half the total weight of bark, has been pure tannic acid.

* "Wattles and Wattle Bark," by J. H. Maiden, F.L.S., Sydney, 1890.

From examinations of this wattle made by direction of Professor Hilgard in 1884,* a return of 46.8 per cent of tannin was obtained from barks dried at same temperature, showing conclusively that no loss has been sustained in this essential in the removal of the tree to this country.

Indeed, it would indicate if anything that in some parts of our State this wattle had found a more congenial home than in its native habitat of South Australia; that is, so far as reaching its fullest size and maturity at an earlier age than there.

This is a most important factor, as the consensus of opinion of all investigators is to show that the ratio of tannin increases with the size and maturity of the bark.

Illustrations of their remarkable precocity here, are clearly shown by comparing the records of thirteen tests made by Mr. Maiden of this wattle grown upon Government forests at Belair, South Australia, with our own.

The heights, ages, and diameters of butts of these trees are given:

In age they range from three to seven years; in height, from eight to fourteen feet, and in diameter, from one and three fourths inches to four and one half inches.

All the trees upon our Santa Monica plantation indicate a growth about twice as rapid as this. None of our trees are planted over twenty months, and are about two years (twenty-five months) from the seed.

Many of them now exceed a butt measurement of four inches in diameter and a height of sixteen feet, figures only reached in the samples sent to Mr. Maiden after a growth of five to seven years.

The poorest of ours exhibit a diameter of two inches and a height of nine feet—results requiring three or four years to accomplish there.

It is not so stated, but the presumption is that the bark sent Mr. Maiden was from wild, bush, or uncultivated specimens, and it should be borne in mind that ours were reared under precisely these conditions, and have had neither care nor cultivation, nor irrigation from the day of their planting out.

Were these proportions to continue and be general, we might reasonably expect to obtain a crop in three to four years that should equal the yield requiring seven or eight years to obtain in Australia.

I have measured *Acacia pycnantha* grown in various parts of the State measuring twenty-four to twenty-eight feet in height, and with butt diameters of seven to eight inches, but no official or accurate record of their age is obtainable, nor the extent of care or cultivation they may have received. The authorities cited by Mr. Maiden all concur in agreeing that, with cultivation, a size and maturity can be obtained in five years that they will require seven to eight to reach in an uncultivated state, and if the profits alleged are as great as represented, growers here would be justified in giving them the highest possible tilth.

Some of the tables of profits and expenses figured out by him date back as far as 1878,† while as recent figures as Mr. J. Ednie Brown's report to the South Australian Legislative Council in 1884 are given as well as those of Mr. Perrin, Conservator of Victorian Forests for the year 1889.

All of these tables, though compiled by specialists of the highest standing, are nevertheless only estimates, but seem to have inspired the full-

* See Report University of California for 1884, p. 73.
† Report of the Victorian Board of Inquiry into Wattle Barks, p. 27.

est confidence, as the correspondence of this Board has brought us in communication with many individuals in both New Zealand and Victoria, who have undertaken recent plantations upon scales ranging from four hundred to one thousand two hundred acres.

The net profits per annum per acre, as figured out in the earliest report, amount to $16 40, the product being estimated on the bark of *Acacia decurrens*. Mr. Brown's, upon the Golden Wattle, only reaches $8 per acre, and the most recent amounts to about $23 50 per acre from the same bark. Mr. Brown's estimates, it should be stated, include cost of the land at $15 per acre; others only include a charge for rental; all make allowance for every possible contingency, and incomes are based upon market quotations of bark, ranging from $25 to $37 50 per ton.

Conservative enough in every particular for our purpose, as the California product, if holding up to the analysis of barks grown here, would readily command a higher price than the greatest figure quoted.

Returns are expected to come in the fourth year, and to continue over the fifth, sixth, and seventh; the crop, during these four years, amounting on an average estimate of one thousand to twelve hundred trees per acre, to furnish a total of six and one half tons per acre during the seven years; and the estimated profits named are not upon the three to four yielding years, but distributed over the whole seven, from the time when operations begin.

No account is taken of the yield of fire wood obtained, which in California, where if plantations were not too remote from market would be a very important element in the results.

The fuel rating of many of the wattles is excellent; that of the Golden being of the very highest, and on a conservative estimate of ten cords per acre, and at the lowest price at which any standing fuel of poorest quality is rated in Southern California, to wit: $2 50 per cord, the revenues from this source would probably alone cover all outlay, leaving the bark as the profit resulting from the enterprise. The only objection that seems to be raised against the Golden Wattle is its small size when compared with other species, and a consequent diminished yield per acre of bark. Now the examples we have mentioned show that upon good soils, and with probably a little care, it will develop to a tree of more than medium size, and a consequently large yield of bark.

Again, upon these lowest and most conservative estimates, which unfairly include the cost of the land, the net income of only $8 per acre, excluding value of fuel as well, would justify the conversion of the best grain lands of our valleys into wattle plantations; for it is a notorious fact that the net income per annum, per acre, from grain farming does not reach that figure throughout this State.

It is a moot question if irrigation could be expediently resorted to, it being claimed that excess of moisture stimulates foliage growth at the expense of the bark, which becomes thin, flabby, and deficient in tannin.

We would compromise upon this point by stimulating with water and cultivation, and every means available during the first two years, for the sake of the ground shelter by the shade quickly afforded, leaving the trees subsequently to develop their maturity and bark properties more slowly and naturally.

Other points which commend this tree to our attention and perhaps more than compensate for its smaller size are:

First—Its wider climatic range, enduring more cold and heat than

either of the two species previously named, and thereby extending the area of its successful growth in California.*

Second—Its undisputed adaptability to *all* lands not strongly alkaline. Have seen it growing in so called "adobe" lands, stiff clays, alluvial sediments, loams, gravelly barrens and loose sands, with greater thrift and vigor than shown by the other species under like conditions.

Where the climate suits, and rich lands are devoted to this purpose, *cæteris paribus*, better returns may be anticipated from the larger trees of the Black Wattles, but upon so called waste and arid lands, growths made by the Golden Wattles are far superior to the others.

Character of soil is alleged to exercise great influence on growth and yield of tannin. The report of the Victorian Board of Inquiry discriminates against limestone soils as inimical to such results. Our own observations, so far as the species under consideration is concerned, contradict this somewhat strongly in the former particular, and apparently in the latter as well, according to Mr. Maiden's numerous analyses.

The excellent growths made at our station in two years or less, to which we have heretofore referred, were made upon limestone soils, equal success resulting upon soils where the lime was either in the form of chalk or gypsum; while the excess of ferric oxide in the soil, and which prevails in so much of our foothill lands, at least serves to keep the soil in a state of disintegration beneficial for the absorption and retention of moisture.

In "ferruginous loam soil," Mr. Goyer, of Adelaide, analyzed bark from seven-year old trees that produced one hundred and twenty-eight pounds of bark, yielding 31.4 per cent of tannin, and of tree of same age grown in calcareous sand, 31.7 per cent of tannin was had, which would seem not to indicate anything very detrimental from the presence of lime.†

From a tree estimated at thirty years of age and producing no less than three hundred and seven pounds of bark and grown upon deep sand, only 25.8 per cent of tannin was obtained, seeming to prove that no gain in tanning properties result from leaving the crop ungathered till a great age is reached.

The dimensions of this tree unfortunately are not given, but as the bark was less than one fifth of an inch in diameter (0.18), it proves conclusively that the tree sometimes attains to considerable magnitude.

Still another point remains in favor of the Golden Wattle, to wit: its free fruiting qualities, which makes the seed at all times cheap, abundant, and easy to obtain.

Summing up briefly, we find to its credit: A greater resistance to cold than the others; a greater percentage of tannic acid; adaptability to more varied soils; greater cheapness and facility of obtaining seed; probable maturity of its crop one or two years earlier than the others.

To its discredit: Smaller size and consequent smaller yield of bark and fuel per acre.

This brings us to the consideration of the other two species, and before we make any suggestions as to cultivation or propagation, the treatment

* From a letter, learn that small plants of *Acacia decurrens* sent out by us last winter to the Cholame Valley were killed by frost, (temperature not stated); the *A. pycnantha* escaped unhurt.

† Mr. Maiden, l. c., seems to think these analyses do not give full yield of tannin—errors in the right direction.

for one being applicable to all, will speak of the confusion attending the identity of three distinct species of so called Black Wattles, to wit: the *Acacia decurrens*, *A. mollissima*, and *A. dealbata*.

That this confusion is not confined to California is well proved by the fact that the greatest authority* on the genus, goes into exhaustive details to illustrate the difference in the three. Mr. Maiden devotes a chapter to their mutual similitude and dissimilarities, and the Report on Wattles from the University of California† promptly disposes of the whole subject by stating that the two (*A. decurrens* and *A. mollissima*) are "easily distinguished when in fruit."

True enough, yet as they are not always in fruit, and never so in the young state, it becomes at times somewhat perplexing for the trained observer to separate them. Even the silvery color of *A. dealbata*, except it be in juxtaposition with the others, will not declare it, as all are more or less whitish canescent.

The differences in fruit (pod) are striking enough, but the seeds as offered in the market are almost indistinguishable, except in minutest botanical details and inconsiderable differences in size, a feature, we need not add, so apt to be variable that fullest confidence in the source of supply rather than the dealer's knowledge or good intentions, becomes a point of interest to the general planter, who may not be educated up to these critical points of difference. Mr. Maiden sums up the situation strongly in the following words:‡

> Careful examination of the subjoined comparative table will show that there are no sharp lines of demarkation between the three species, and those botanists who look upon *A. mollissima* and *A. dealbata* as varieties of *A. decurrens* take up a position which is apparently as strong as those who divide them into separate species.

Here in California this confusion has overrun all necessary bounds, and resulted in the widespread distribution of such a comparatively worthless tree as *Albizzia lophantha*§ as the "Black Wattle." I am unable to ascertain the sources of this distribution, but during the past summer, in answer to numerous appeals for samples of bark made by this Board in order to secure enough to furnish practical tanner's tests, in the majority of instances I received bark of this tree; fortunately, I had bespoken specimens of foliage, flowers, or fruit, and thus discovered the error in time to avert imposition upon the tanners, and discredit upon the business of wattle growing in California.

Of course such errors as these are inexcusable, but that the confusion of these three allied species is not always to be avoided, we quote upon the authority of Messrs. Blackley, Young & Co., of Rangiriri, New Zealand, who have a three thousand-acre plantation of *A. decurrens*, that the Tasmanian Government have large plantations of *A. dealbata*, the seed of which was originally purchased for *A. decurrens*.

Upon the authority of Mr. Maiden, we may say that the mischief which might be supposed to follow the planting of this tree for tan

* Baron F. von Mueller in "Extra-tropical Plants."
† For 1882, p. 110.
‡ For 1882, p. 34.
§ *Albizzia lophantha* has no tanning value; the root is reputed to have saponaceous virtues, but the tree is short lived, of little or no value for fuel—in fact, its only merit lies in its surprisingly rapid growth, and we cultivate it extensively for shelter purposes, expecting to plant it out largely among young pineries as a quick and effective means of affording protection from sun and wind.

bark has been greatly exaggerated, and that the Tasmanian Government or any other planter will be amply rewarded with excellent returns.

True, he excludes it from the best list and classifies it with barks of second value, and his analyses accredit it with an average of nearly 22 per cent of tannic acid, as against a general average of 32 per cent for all his determinations of both *A. decurrens* and *A. mollissima.*

These results as obtained by him are far superior to the records published by von Mueller, who only rates the product of *A. dealbata* at about one half the returns had with the others, while he also avers the bark to be much thinner, a very serious consideration if sustained; although Mr. Maiden cannot discover a "pin's difference" in this particular. Samples of bark of both *A. dealbata* and *A. decurrens*, California grown, examined by the writer were of uniform thickness, but only from three-year old trees, and hence not conclusive upon this point.

The Silver Wattle (*A. dealbata*) is reputed to make the largest tree, in moist bottom lands frequently exceeding a height of one hundred feet and having a stem diameter of two feet.

All are of surprisingly rapid growth, and where they grow here, seem like the Golden Wattle to break the records obtained at home.

Mr. Brown mentions trees of *A. decurrens* in South Australia of five years, thirty feet in height and eight inches diameter. Trees which, until they fruit, we must provisionally call *A. mollissima* or *A. decurrens*, may be seen at Colgrove, in Los Angeles County, and in San Bernardino, not yet four years old, which now exceed these dimensions in both instances; however, they are growing in soils of great richness.

At our Santa Monica station some two-year old specimens of *A. mollissima* are twenty-one feet in height, but with the disproportionately narrow diameters of only three and one half inches.*

Authors are agreed in all of these species requiring more moisture than demanded by the Golden Wattle. Our observations confirm this so far as *A. mollissima* goes, which has died out on dry hills where *A. pycnantha* has survived. They also state, however, that sixteen to twenty inches of rainfall are ample to bring it to perfection.

It is also claimed they (these species) will thrive on land absolutely sterile, upon which no other vegetation will thrive; which point we cannot corroborate as yet for California, as reports from Newport Landing, where we are testing this point, are not yet received, and sand reclamations in the Golden Gate Park, San Francisco, have not been made with these species.

The yield of bark is great, being averaged for plantations at seven years to eighty-four pounds per tree. Von Mueller quotes Mr. Dickinson as authority for a yield of one thousand pounds from a single tree in Queensland of *A. mollissima;* and this species, he adds, "is content with the poorest, driest, and sandiest soils."

All of these species will prove valuable, but so long as conflicting opinions exist as to the value of *A. dealbata*—and even its most ardent advocate relegates it to a secondary place—we will dismiss it from further consideration and recommend that initial plantings be made of the other species.

Seed of the *A. decurrens* in small supply can be had by application to this Board during the coming season, and will be distributed over the widest possible limits in which the tree may be expected to flourish.

* Due to close planting.

REARING.

Our experiments with the various methods of planting recommended by foreign planters, have, we regret to say, proved unqualified failures. Not even directions followed, as per recommendation of United States Department of Agriculture in its distribution of wattle seed, have proved much better, and where success has followed, I am of opinion that this success is the result of a fortuitous sequence of favorable conditions that cannot be depended upon for most seasons and most localities in California.

Any ordinary sowing that does not contemplate a partial roasting or boiling of the seed, as is well known, will result in failure to germinate. The roasting, if carefully done, it is claimed only destroys the outer integument of the seed, and it can then be sown without covering of earth, lying dormant and springing up, as in the case of many other forest products, after the first rainfall. Boiling or soaking the seed in hot water induces speedy germination, which makes immediate sowing and covering with soil an indispensable necessity.

Sowing seed broadcast thus prepared, in this State, implies for success a high degree of cultivation, a continuance of night temperatures not much below 50 degrees Fahrenheit and moisture close to the surface.

These conditions are seldom coincident here. At the time of year when we have sufficient warmth of soil (March–April), our rainfall in Southern and Central California is not sufficiently assured to warrant moisture enough near the surface to insure their growth. Seed sprouted previously to sowing will not endure drying out to any extent; its vitality is quickly gone unless conditions are favorable to its immediate growth.

Planting early, with the first winter rains, say December, offers no better alternative; the ground is chilly and cold, and these extra-tropical seeds, stimulated by heat to a condition for immediate growth, are checked, and chiefly decay.

All these wattles, furthermore, though of subsequently vigorous growth, are very slow to "start" during their infancy, and, in one of the rare seasons that occur that might be favorable to broadcast sowing, does and always will result in a spontaneous growth of native weeds and grasses that would quickly exterminate the wattles.

Success with this method, as stated heretofore, granting proper atmospheric conditions, requires careful preparation of the soil; and as our desideratum is to cover non-arable hillsides with these trees, we are necessarily compelled to leave the matter of cultivation out of the question, and abandon altogether the broadcast plan so highly commended for the Australian colonies.

The "hill" system, to wit: the planting of two or three seeds in a hill, like corn, as recommended by the Department of Agriculture, has great advantage over the broadcast or drilled-in Australian plans; it at least admits of sufficient cultivation around each tree to arrest weeds. and, even on steep hillsides, this can to a certain extent be accomplished by manual labor; still success is in the main dependent on the same conditions as in the other, and the little success that we achieved in a few localities last winter (1889–90) was due not to our skill as planters, but to early and evenly distributed rainfall, accompanied, until the plants were well established, with exceptionally high temperatures.

Rearing the plants both in boxes and nursery rows, and then trans-

planting them to permanent locations, we have tried with varying success, with the record showing a greater percentage of failure than otherwise.

This plan, that acts so satisfactorily with most eucalypts, does not comply with the requirements of the wattles; our own observations indicate that, except when very small seedlings, most species are restive of any root disturbance.

To this end we conclude that the only thoroughly satisfactory means at command is, to raise them in pots or some equally serviceable substitute. A little more trouble and expense are involved, but if the final results are to be had from wattle growing which we anticipate, surely this will not weigh as against the possible loss of time and seed incurred in two or three or more seasons of planting by other methods in expectation of an auspicious year.

Our system is to boil or soak our seed in hot water and then, keeping it still moist with wet moss, as fast as germinated to put one seed only into the smallest two-inch flower pot; preferably we use rich soil, as our planting is made June to August, and we aim to stimulate all the growth and size possible before cold weather. At the season of the year named the seedlings grow rapidly, and are, though still small, well established, and may be set out at once in the permanent plantation without disturbance at any time in the winter subsequent to the first considerable rainfall. If the winter be cold, they will grow but slowly, and may be overcome by weeds, unless cultivated; but they will in any case receive a start and impetus that will carry them through the ensuing summer's drought where the winter-sown seed will, even where it sprouts, perish in the early summer from incomplete establishment.

Plants reared in pots will of course exact nursery treatment, frequent waterings, weedings and occasional moving, in order that the plants do not root through into the soil.

The pots may be used the succeeding summer to rear another supply in, and the operation may be thus continued indefinitely.

Still another advantage from this method results from the economy of seed. Its lifelong vitality is well known, and when properly developed by swelling with applications of heat and moisture nearly every seed will produce a plant, each one as fast as germinating being picked out and planted singly in the pot of prepared soil. As these various species we have had under consideration contain from twenty-five thousand to fifty thousand seeds to the pound, and as above 95 per cent of good seed can be expected to produce plants, it will be readily seen that a pound of seed will furnish the making of a considerable plantation—but of numbers planted per acre will speak hereafter.

Rearing in seed boxes, or beds, then "pricking out" or transplanting into boxes, to be there grown until required for setting out in the permanent grove—as is the general practice in this country in rearing eucalyptus—has the advantage of cheapness over the pot method, and is frequently followed by nurserymen; but, as we have already pointed out, owing to the impatience of most species to root, disturbance cannot be recommended to the general public; expert skill and coincident favorable weather must operate to produce a good "stand."

Still we rate the risks *far less* than in any system of broadcast, drill, or hill sowing. The very serious item of investment in pots, amounting from \$8 to \$12 per acre, according to the market where bought, would

prove a fatal handicap to many planters. That brings us to the consideration of still another method which presents a substitute for pots; has most of its advantages—indeed, in some particulars greater merits—is highly commended by Mr. J. Ednie Brown, Conservator of South Australian Forests; and, in fact, is the only method proposed for rearing trees there, which I am prepared to indorse fully as meeting all the requirements for California planting, and as coming within the probable means and reach of all.

His plan is to cut the hollow shoots of bamboos into four-inch lengths, fill with soil, plant the germinated seed in each, set them closely together in boxes, give them ordinary nursery care, and when of sufficient size to set, plant bamboo and all in the place where the tree is to grow.

When the bamboo or "tube" does not sufficiently decompose at the time of planting, a single blow of knife or sharp trowel splits it down without disturbance of the ball, and affords immediate opportunity for root expansion.

These tubes are of no value for ordinary nursery operations in which pots are used; the conical form of the latter permitting the plant to be removed without injury to ball or pot, and the "shifting" of the former into a larger size pot for further continued growth. Plants cannot be so shaken from the tubes without that complete root disturbance we are so anxious to avoid.

There are so few plantations of bamboos in California, and these so highly prized for ornamental purposes, that our recommendation would fall very flat and impracticable had not the complete adaptation of the common cane (*Arundinaria macrosperma*) as a substitute proved in every way satisfactory. It is abundant along many watercourses in the State, being most prolific along the waterways of the older towns and cities.

In the vicinity of San Bernardino and of Los Angeles alone, enough could be cut to make many millions of these tubes.

One of our correspondents has cut up into lengths and made nearly one thousand of these in one working day, while the operation of filling and seeding occupies no more time than would be consumed in the same work with pots.

Most of the wattles make an extensive and early tap-root, which is quickly checked in a shallow two-inch pot with a corresponding restraint to growth of top, which from experiments in vessels identical in shape and size to these tubes does not occur. So fully satisfied with the promise of this method is our Board, that our own planting the coming season (to the extent of fifty thousand trees) will be exclusively made in them.

PLANTING

In California may be carried on through the winter, and in the interior valleys, where heavier and later frosts may be expected, until as late into the spring as moisture remains in the ground, and where tube or pot planting is followed, and where facilities for irrigation exist, throughout the hottest portion of the summer.

CULTIVATION.

We have succeeded in obtaining a good growth of wattles upon hillsides, where only one hand cultivation with a hoe to kill the first crop

of weeds was had; in fact, horse or machine cultivation would have been impracticable, but are well satisfied that where the nature of the land will permit that one or more plowings, harrowings, or scarifying of the entire surface of the land during the first two years can be had, it will more than repay in accelerated growth, vigor, and earlier maturity of the crop all the expenses incident thereto. Those who have ever practiced spring or summer irrigation, and resort to this as a means to promote growth, will understand that subsequent tillage is a prime necessity.

In order to facilitate this cultivation we recommend planting in rows, not necessarily with orchard-like precision, but with care enough to permit of horse cultivation for two seasons.

The United States Department of Agriculture's recommendation is for planting four by four feet, about two thousand seven hundred trees to the acre. Some Australian planters, who broadcast, or line out, recommend thinning out, some to six by six feet, or say, one thousand two hundred trees to the acre. Still others, ten by ten feet, or four hundred and thirty-five to the acre. The dense planting where no cultivation whatsoever is permissible, is perhaps the best, as a complete shade is most quickly effected, otherwise, we condemn it, our own tests showing a disproportionately whip-like growth of stock or trunk. The six by six feet planting has the disadvantage of not allowing for cultivation after the first year, and ten by ten feet permits of too extensive a growth of top and lateral branches, always a disadvantage, if either bark or fuel, or both, be the desideratum to be obtained.

Our future plantings will be four feet apart in the rows, and rows ten feet distant. This will readily admit of cultivating one way for two or more years, if desired; permits of the entrance of teams or wagons for removal of bark, fuel, or other purposes; and it furthermore allows of planting nearly one thousand one hundred trees to the acre, sufficient for a proportionate development of top, and yet close enough to secure the straight, spar-like growth so helpful to future operations.

The stripping, curing, and marketing of the bark are simple enough, and will offer no serious obstacles to the planter; and as they will form the subject for a future memoir, need not be dwelt upon now, or till such time as a harvest is imminent.

In review, we repeat once more, that for lands not susceptible of much or any other than initial cultivation; for lands of such sterility that they are unproductive of native vegetation, or for localities where the mercury may be expected to register as low a temperature as —6 degrees Centigrade (21 degrees Fahrenheit), or where the annual rainfall falls under sixteen inches, we commend the *Acacia pycnantha*, or Golden Wattle, as an easy first. In all other cases, we think the weight of advantage lies with either of the Black Wattles—the *Acacia decurrens* or the *A. mollissima*. Any of the three, we are satisfied, will yield returns to the planter commensurate to the labor and capital employed, and from their rapidity of growth all will contribute largely towards the beneficial effects which must accrue to every locality that prosecutes the planting of forests to any considerable extent.

PART V.

REPORT ON CHICO EXPERIMENTAL STATION.

The property of the Board at this point embraces a great diversity of soils—in fact, illustrates nearly all that are found in either valley or foothill of the upper Sacramento—and results in tree planting finally attained here will prove typical of the requirements, or rather the possibilities of a very large region.

Tests made with a number of species of eucalyptus have not to date furnished gratifying results. Three species, to wit: the *Eucalyptus rostrata*, *E. viminalis*, and *E. obliqua*, have during two years withstood the normal winter temperature with perfect success, but have failed to make as satisfactory an annual growth as the same species in the southern half of the State.

Remarkable success has attended the planting of nearly all coniferous species, the Redwood and Lawson Cypress alone proving unmanageable under the summer temperature.

Pinus pinaster (Cluster Pine) has here fully demonstrated its cosmopolitan character, making so excellent a showing upon the various soils where we have tested it that we shall undertake the rearing of it here during the coming season on a large scale, with a view not only to making this station a distributing point for this tree along the Sierra foothills, but in the belief that the State will turn over to this Board the control of some of its depleted school lands, upon which we may make extensive plantations of this prolific and invaluable yielder of turpentine and allied products.

Most of our native conifers have made reasonable growth, but have been excelled in general vigor by exotic species—notably, both the Austrian and Scotch Pines, which seem to conform themselves more readily to the low elevation than the natives.

Herewith we append a list of such species as we now have growing at this station, with general notes or observations where pertinent:

No.	Name.	Country.	Remarks.
2,468	Eucalyptus viminalis—"Manna Gum"	Southeastern Australia	Most satisfactory gum tried.
1,188	Catalpa speciosa	Western United States	Largely planted over clay hardpan—results poor.
1,652	Pinus Austriaca- Austrian Pine	Europe	Results excellent; better than at southern station.
1,658	Cupressus sempervirens—Evergreen Cypress	South Europe	Rapid growth with minimum of care.
974	Neg r"	California	Better growth upon cement or clay hardpan than made by Catalpas.
763	Acer rubrum—Soft Maple	Eastern and Northern United States	Not able to resist summer drought.
708	Pinus pinaster—Cluster or Maritime Pine	South Europe	Results on all soils excellent.
560	ngy bark"	Tasmania, Victoria	Growth inferior; even upon deep good soils.
470	ouglas Spruce"	Western United States and Pacific Coast	Better growth than any "native" conifer.
420	Eucalyptus rostrata—"Red Gum"	Australia	Not as good returns as from "Manna Gum."
372	Chamæcyparis Lawsoniana—Lawson Cypress	Northwest Coast	Sunburns here.
306	Acer dasycarpum—White Silver Maple	Eastern United States	Far better tree for this locality than the Red Maple.
280	Salix alba var. vitellina—"Golden Osier"	Europe-Asia	Planted on our dampest land, but without summer moisture, made a growth of ten feet in a season.
228	Thuya ('Arbor Vitæ"	Eastern United States	So far stands dry exposures well.
210	Juglans n Black Walnut	Central United States	Good results had with both walnuts upon varied
201	Juglans ifornia Walnut	Western United States and California	soils; nearly failing, however, on shallow soils.
174	Sequoia sempervirens—California Redwood	California	Promises poorly.
160	Populus monolifera—Carolina Poplar	United States	Better growth upon dry sites than we have had with other poplars.
984	Pinus strobus—White Pine	Eastern United States	Progress satisfactory.
159	Pinus sylvestris—Scotch Pine	Europe	Growth better than at southern station.
150		Japan	Vigorous everywhere.
123	ne	California	Rates under like conditions
100	;"	California	
73		Europe	General results excellent.
70	ne	Southern California	Growth better at southern station.
57	lue Ash	United States	Stands dry exposures fairly well.
56	Betula alba—White Birch	Eastern United States	
47	Morus alba—White Mulberry	Asia	
38	Melia Azederach—Pride of China	Asia	
24	Japan maples varieties	Japan	
151	'ir	West Coast	
9		Europe	
6			Planted for ornament.
4		Southern United States	Planted for ornament.
2	in Pine	Queensland	Planted for ornament.
4		Western United States	Results poor.
4		United States	Results poor.

Total in plantations at Chico Station, 15,437.

In addition to the foregoing list, we have about thirty thousand seedlings of the above varieties for distribution from this station for the approaching season, it being the intention of the Board to make this a distributing point for the northern portion of the State.

While sacrificing nothing from a forestry standpoint, an effort has been made to dispose of plantations at this point with regard to ornamental effects. Its proximity to the town of Chico makes it desirable that park-like results shall be attained. It will thus not only subserve all the uses of an experimental forest station, but in the immediate future become a place of resort, amusement, and instruction for the people of that part of the State.

W. S. LYON, Forester.

PART VI.

APPENDIX.

SANTA BARBARA, September 29, 1890.

To Mr. WM. S. LYON, *Forester, Los Angeles, California:*

DEAR SIR: I planted the eucalypti the Board kindly sent me last spring upon a south-hill slope. "Sewell's Red Gum" first, and on best soil; then Red Gum, and highest up the *Eucalyptus diversicolor*.

Sewell's Gum are all dead except one or two, and these have not made any perceptible growth.

Red Gum have made a wonderful growth, some of them seven or eight feet high; *E. diversicolor* nearly as great a growth, and all are very thrifty.

No cultivation or water; the holes were barely digged big enough to crowd in the roots. The growth surpasses belief. * * *

Respectfully,

S. S. PRICE.

SHASTA, November 5, 1890.

To State Board of Forestry:

GENTLEMEN: I have to write to you concerning the cutting of Government timber. * * * I have to say there is a wholesale steal going on at Iron Mountain, Shasta County. There have been Government (United States) agents at that place, but they have failed to put a stop to it. * * * What I want to know is, how to proceed to inform against the company. Please send me the desired information, and oblige, Yours, respectfully,

(Name withheld.)

ROSAMOND, KERN COUNTY,
November 5, 1890.

To W. S. LYON, *Forester:*

DEAR SIR: I would like your opinion as to the trees best adapted to the following situations:

First—Rocky hills, indefinite depth to water, and no facilities for irrigation; 108 to 115 degrees Fahrenheit in summer in the shade, and ice forms about one half inch thick in winter.

Would the tree best adapted to the above conditions do equally well if watered, or if planted on ground where surface water is not more than twenty feet below surface?

Second—What tree would do best on heavy clay soil, thirty inches to four feet to water; the surface of the ground occasionally submerged—probably every winter—from six inches to two feet; other conditions, as

concerns climate, same as above; submerged condition of this land would perhaps continue three or four months.

Can seeds of the varieties best suited to the above conditions be obtained of the State Board of Forestry, and upon what conditions? I have charge of a quantity of hilly land which is of no value, unless I can get some kind of forest trees to grow upon it. It goes without saying that I want a tree which will be commercially profitable.

Hoping to hear from you soon, yours truly,

CHAS. W. McMASTER.

San Miguel, San Luis Obispo County, November 3, 1889.

Wm. S. Lyon, *State Board Forestry:*

I write for information in regard to tree planting on timber culture claim, which is situated in Fresno County, near the foothills, on the west side of the valley. No system of irrigation in the vicinity; will have to plant something that rabbits and gophers will not destroy; have been advised to plant the eucalyptus, and some recommended putting in the seed and dragging it as you would for grain, then thinning out the trees after a year's growth. What is your experience with the seed, and could it be made to grow in that way by putting in early in the fall so as to have the benefit of all the rain of the season? Would like an answer soon.

Very respectfully,

I. JANETTE COYLE.

Santa Rosa, November 14, 1889.

W. S. Lyon, *Forester, Los Angeles:*

Dear Sir: I have about one and one half acres of land on which the water is inclined to stand in winter, and it gets baked rather hard in summer. It is slightly alkali, and the soil not very deep.

What tree would grow on it that would make the best wood in the shortest time, and can you send me seed of the same?

Have heard a species of eucalyptus called the "Iron Bark" highly recommended.

Yours respectfully,

GEO. S. THURSTON,
Santa Rosa, Sonoma County, Cal.

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35 Cortland Street, Chicago, September 10, 1889.

To California State Board Forestry:

Gentlemen: I am in need of certain information, which it has occurred to me you will be able to furnish. This is my apology for troubling you.

I have taken a Government tree culture of a quarter section in Kern County, Cal., in the immediate vicinity of Lake Buena Vista, between

that and the mountains of the coast. The soil is rich and deep, and, I think, very well adapted to my purpose—which is to raise English Walnut trees, if they are allowed by Government as coming within the requirements of the law as forest trees. If they do not, I hope you will inform me.

Second—May I reasonably expect to raise from seed that kind of trees upon that land as it is without irrigation, depending only on the rainfall and natural moisture of the atmosphere?

Third—Is it best to propagate from seed on the spot where the tree is wanted, avoiding transplanting, or to obtain seedlings and have them planted where wanted?

Fourth—Is a fence necessary to keep out rabbits and gophers or will they, if permitted to get at the young plants, destroy them?

Fifth—If these are destructive, what is the best means to rid the land of them?

Sixth—If, in your judgment and knowledge of this location referred to, you are of opinion that English Walnuts cannot with good hopes of success be raised, will you kindly mention the kind of tree that is best adapted to the land? And in so doing confer a great favor on

Yours truly,

THOS. COYNE.

HESPERIA, SAN BERNARDINO COUNTY,
March 28, 1890.

W. S. LYON, *Esq.*:

DEAR SIR: I have ten acres of land that I wish to set in forest trees in the future, but I would rather experiment on some varieties to see which kind would do best. The land is a sandy loam—and the Juniper grows in it—three thousand feet above the sea level, and situated two miles north of Hesperia.

I would appreciate very much if you would send me some trees of varieties you may think advisable.

Respectfully yours,

ED. DOLCH.

PASADENA, CAL., November 6, 1889.

To Chairman State Board Forestry:

DEAR SIR: I have a timber culture claim in Antelope Valley, and as you know the law requires ten acres to be planted to timber, I would like to ask your advice as to the *kinds* of timber that are most likely to live and do well in that region during the hot summers.

I thought you would be able to give me the desired information, and also where I could procure Maple and Mesquite seed, as I am desirous of trying those two varieties.

Grateful for such information as you can give,

I am, yours respectfully,

G. F. MILES.

COMPTCHE, MENDOCINO COUNTY, July 21, 1890.

State Board of Forestry:

GENTLEMEN: I herewith acknowledge receipt of, and thank you for the fire notices, which I deem highly instrumental in preventing reckless parties from burning our forests. I will put them in the most favorable positions possible. * * *

Sincerely yours,

G. F. MEDDOCK.

UNITED STATES INDIAN SERVICE, MISSION AGENCY,
COLTON, CAL., July 22, 1890.

Mr. WILLIAM S. LYON:

DEAR SIR: Am pleased to receive the fire notices, and will endeavor to keep them posted within the district which I cover in caring for the Indians.

There is a cañon east of San Jacinto full of beautiful fan palms, very large.

The Indians, for no known reasons, are destroying them, and I have tried in vain to stop it, but see no way but to put a man there to watch, and get one severely punished. This, I believe, may save them. Can you employ a man for this purpose?

Truly yours,

HORATIO RUST,
United States Indian Agent.

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140 NASSAU STREET, NEW YORK,
June 23, 1890.

To State Board of Forestry:

GENTLEMEN: Mr. B. E. Fernow, Chief of Forestry Division of United States, Department of Agriculture, suggests that you might kindly forward copies of 1887–89, Reports of California State Board of Forestry, of which he has none at present. Can you do so? If you could also point me to any published statistics of the prices of White and Yellow Pine in San Francisco, and the markets sought by the northwest lumber output, you would confer great obligations on yours,

Very respectfully,

WALTER S. CHURCH.

GALT, SACRAMENTO COUNTY,
January 27, 1890.

Mr. WILLIAM S. LYON:

DEAR SIR: The trees, some sixty in number, arrived in due time and in fine shape. I will report next season. Can you give me something of their history; are they all of Australian origin?

Yours truly,

J. B. DUFFY.

NUNACH, CAL., November 19, 1889.

To Commissioners of Forestry:

SIRS: We, the undersigned, citizens of Antelope Valley, in Los Angeles County, State of California, and members of the La Liebre Farmers' Club, desire you to send us as many trees as are allowed by the Commissioners, and of kinds best suited to our valley.

And we hereby agree to plant, cultivate, and otherwise care for the same, in accordance with such instructions as may be given by said Commissioners of Forestry.

(Signed:)

F. M. SPEER,
ELLIS FAY,
GEO. A. OWENS,
FRANK TRY,
And sixteen others.

REDLANDS, CAL., January 18, 1890.

To WM. S. LYON, *State Board Forestry:*

DEAR SIR: I am about to plant out thirty acres with ornamental trees and shrubs, and greatly desire information about trees and shrubs suitable to our climate here at Redlands. * * *

Yours, very truly,

ALBERT K. SMILEY.

BIG DRY CREEK, FRESNO COUNTY, CAL.,
January 31, 1890.

WM. S. LYON, *Esq.:*

MY DEAR SIR: Can you direct me where to obtain the seed of the *true* Golden Wattle? Is this the ordinary acacia? [Here follows descriptions.] I am informed they grow in dry soils without any irrigation, and have a bark of great commercial value, and make excellent firewood. * *

Truly yours,

H. C. CONE.

REDLANDS, CAL., July 9, 1890.

To Mr. WM. S. LYON, *Forester:*

DEAR SIR: I want to plant some Sugar Gums on a dry hillside, but where I can water occasionally, if it is best—of course I expect to water them the first year. Now, will it be necessary to water them the second year, and would you advise me to plant Sugar Gums instead of *Eucalyptus globulus?* Also, how high will they grow?

An answer to these queries will greatly oblige.

Yours, very truly,

E. G. JUDSON.

SISSON, SISKIYOU COUNTY, CAL.,
February 28, 1890.

To State Board of Forestry:

GENTLEMEN: I shall esteem it a great favor if you will give me information as to the best trees to plant for ornament and shade to surround

my town property. I desire rapid growths with a broad leaf. Soil is deep, red loam, diffused with lime, gravel, and sand. It forms a fine cement. Water is abundant. Trusting that I am not encroaching, etc.,

I am, most respectfully yours,

PETER MUGLER.

FAIRFIELD, SOLANO COUNTY, CAL.,
March 6, 1890.

To W. S. LYON, *State Board of Forestry:*

DEAR SIR: I desire to set shade trees on the streets of our town. The soil is a heavy adobe; can you advise me as to the trees best suited for this purpose? Would Horse Chestnut, California or English Walnut, or Silver-Leaf Maple grow in our soil, or would some other kinds be more suitable? * * *

I am yours truly,

REV. D. M. BIRMINGHAM.

PASADENA, CAL., November 20, 1889.

To State Board of Forestry:

GENTLEMEN: Please inform me what varieties of quick-growing trees are best adapted for fuel and windbreaks. How far apart should the seed be placed, and what preparation of the ground and cultivation afterwards are required? Also, any other suggestions as to planting and attention. About how much seed will be required to the acre for a fuel plantation? * * *

Yours respectfully,

H. A. THACKER.

SAN BERNARDINO, CAL., February 27, 1890.

WM. S. LYON, *Esq., State Board of Forestry:*

DEAR SIR: Yours was duly received, and also the acacia seed. Many thanks for them, and for the information you gave me concerning the tree. Still, I desire to learn more, and will ask a few more questions. What is the general form of the tree? Is it tall and straight, or does it branch out? Is the foliage dense enough to make a good windbreak? We need a tree more for that purpose than any other, and a tree that would fill that bill and take care of itself would be a great boon to this section of the country. Will it bear transplanting? What is the bark used for?

Which of the two cuttings you find inclosed is *Acacia pycnantha?* They were sent to me as *A. pycnantha* and *A. floribunda.*

Have you ever tried the *Acacia lophantha;* if so, with what result?

Have you ever tried the *Eucalyptus rostrata?* So far it has given me the best satisfaction on dry sandy soil of any of the eucalyptus I have tried.

Respectfully yours,

O. P. ROBERTS.

SAN DIEGO, CAL., February 20, 1890.

To WM. S. LYON, *Esq., Santa Monica Forest Station:*

DEAR SIR: I am referred to you for information in regard to the best trees to plant in Southern California for park purposes. Am improving a hundred-acre tract of the park which I dedicated to the city of San Diego for charitable uses, and upon which will be established an orphans' home, industrial home, school of technology, etc., and I desire to adorn and beautify it in the best way possible. * * * I write for the purpose of asking your counsel and advice as to the best trees to plant, and suggestions as to the best methods by which to accomplish my purpose. * * *

Yours very truly,

BRYANT HOWARD.

GRASS VALLEY, NEVADA COUNTY, November 7, 1889.

To Chairman State Board of Forestry:

DEAR SIR: We desire information relative to the varieties of trees, and method of obtaining some from the State nurseries suitable for the foothills of Nevada County, at two thousand feet altitude, where there is now a scattering growth of Manzanita, Digger Pine, Sugar Pine, Cedar, White Oak, Yerba Santa, and Red Bud. Soil, red gravelly loam, alternating with lighter loam and frequent float rock. This season (unusually dry) two dug wells struck water, respectively, at ten and twenty feet. Any particulars thankfully received by

Yours truly,

EQUITABLE COÖPERATIVE HOME BUILDERS.

DELANO, KERN COUNTY, CAL., February 17, 1890.

To WALTER S. MOORE, *Esq., State Board of Forestry:*

DEAR SIR: Having been informed that you have for distribution varieties of forest trees for experimental purposes, I ask if you would kindly furnish me with a few that you think suitable for our county. We have a supply of water for promoting their growth, and will, if required, report at proper periods as to their success in our station. The soil is a gravelly sand.

Respectfully yours,

GEO. A. TILTON.

SUTTER CREEK, AMADOR COUNTY, CAL., February 15, 1890.

To Chairman State Board of Forestry:

DEAR SIR: Can I obtain a few shade or ornamental trees of you for cemetery planting? Should like them properly labeled, and promise, in

the future, to give all the information possible as to their growth, progress, etc.

Yours very respectfully,

WM. MOLONEY.

BURSON, CALAVERAS COUNTY, CAL.,
December 19, 1889.

Mr. WM. S. LYON, *State Board of Forestry:*

DEAR SIR: I am located in the western part of Calaveras County, between Burson and Valley Springs, on the line of the S. J. & S. N. R. R., and within what is known as the thermal belt of the foothills of the Sierra Nevada. Land is hilly and rolling; soil variable, from dark sandy loam to red soil and adobe; frosts very light; seasons early; rainfall ten to twenty inches; have no irrigation yet; oranges do well in the vicinity, and fruits mature early.

Would like to try a few trees, perhaps a dozen varieties of the kinds the Board is distributing, and such as you think adapted to my locality.

If you are so kind as to send a few such specimens to my address, I will endeavor to make a careful test of them, and report as required.

Hoping to hear from you soon, am respectfully,

W. C. DAY.

CHOLAME, SAN LUIS OBISPO COUNTY, CAL.,
January 28, 1890.

DEAR Sir: I would be most pleased to receive some varieties of trees if the Board has any for distribution, as I am trying every kind to see which does the best. I have a quarter section of land—some of it valley and some a little hilly. In the valley the soil is somewhat adobe, and the hills are black loam over a red sandy gravel. Now, I would like to set out five acres in valley and five acres in hills, and would like such information concerning the care and planting of the trees as you can give.

By answering the above you will greatly oblige.

MRS. MARY KELLY.

RIVERSIDE, CAL., November 9, 1889.

State Forestry Commission:

GENTLEMEN: Have you any seeds of the "Camphor Tree" and of the "Giant Bamboo?" * * * If you have none, can you tell me where they may be obtained?

Yours truly,

THOS. P. EDWARDS.

LOS ANGELES, le 11 Février, 1890.

M. LYON: Voudriez-vous être assez bon de m' énvoyer un paquet de graines de eucalyptus ficifolia si vous en avez?

Adressez "Station B," Los Angeles.

Dan cet espoir je vous prie d'accepter mes bien sincère salutations,

TH. ROUSSINET.

LODI, SAN JOAQUIN COUNTY, CAL., December 16, 1889.

W. S. LYON:

DEAR SIR: Please let me have as many kinds of forest tree seeds as the Board can spare, and oblige.

J. B. MERRILL.

RIVERSIDE, CAL., November 2, 1889.

State Forestry Commission:

GENTLEMEN: Have you any seeds of the "Camphor Tree" and of the "Giant Bamboo?" * * *

Yours truly,

THOS. P. EDWARDS.

SARATOGA, CAL., December 13, 1889.

W. S. LYON, *Esq., State Board of Forestry:*

DEAR SIR: I am a newcomer here, and am trying to improve an eighty-acre ranch in the Santa Cruz Mountains, and would be thankful for such trees or seeds as are suited to this locality, and which would help me in producing shelter quickly. * * *

Respectfully yours,

N. W. SCOTT.

PALMDALE, CAL., February 16, 1890.

W. S. LYON, *Esq., care State Board of Forestry:*

SIR: Referring to inclosed notice with signatures, I inform you that the Palmdale Improvement Society has organized to-day, and elected for its President John F. Fintel, and Secretary, John Muns. The society has instructed me to ask you if the State Board of Forestry could furnish us with an assortment of forest and shade trees for trial in our colony? We shall leave to your judgment what is most suitable for our climate, the temperature going down here to 12 degrees above zero, and the air in summer very dry, and free from fogs. * * * It shall be our endeavor to give all trees the best of care, and report in time the growth made, etc. * * *

Very respectfully yours,

JOHN MUNS,
Secretary Palmdale Improvement Society.

ESCONDIDO, SAN DIEGO COUNTY, CAL., March 3, 1890.

State Board of Forestry:

GENTLEMEN: Desiring to plant out some forest trees in our school grounds, we apply to you. Can you send us any trees desirable for such purposes? We could use forty, probably more.

Yours respectfully,

BOARD OF TRUSTEES,
Oakdale School District,
W. W. HORINE, Clerk.

PERRIS, SAN DIEGO COUNTY, CAL.,
December 12, 1889.

W. S. LYON, *State Board of Forestry:*

DEAR SIR: If you have any tree seeds or plants that you would like to know the results of in this locality, I shall be only too pleased to try them. Have a good place, water in abundance (if needed). Altitude, one thousand five hundred feet; thermometer ranges from 40 to 80 degrees from October to May, and from 70 to 105 degrees in summer. Four kinds of soil: sand, loam, red-land, and adobe.

Respectfully yours,

THOMAS ROSE.

WAUKENA, TULARE COUNTY, CAL.,
December 23, 1889.

DEAR SIR: On what terms can seed be had from the State Board of Forestry, for use in this portion of the State?

Respectfully yours,

A. D. EDGERLY.

INDIO, COLORADO DESERT, January 15, 1890.

Mr. W. S. LYON:

Received the trees all right, but will not set them till all the danger from frost is over; but I fear it is too cold here even for the hardy eucalyptus, but will do all I can for them. Last February three eighths of an inch of ice formed, and it froze one quarter inch thick every night from the seventeenth to twenty-fourth. * * *

Yours respectfully,

P. H. GALE.

PLEASANTON, ALAMEDA COUNTY, February 12, 1890.

The State Board of Forestry:

GENTLEMEN: The trees received of you last spring (eucalyptus variety) have made an excellent growth, considering the meager rainfall of last winter. They have had no irrigation, some of the varieties doing as well as *Eucalyptus globulus*, which is considered the quickest in growth in this county. As to hardiness it is yet too early to say, but I think if we had one or two mild seasons the trees would attain sufficient size to resist such frosts as we had in 1887. The *Eucalyptus marginata* planted last March has made the least headway of any of the varieties sent, with the exception of *Eucalyptus obliqua*. Average height now only ten inches, but *Eucalyptus obliqua* was tried, and though of slow growth at first, it did very well the second year. * * *

Yours very truly,

JOHN C. MOHR.

ALPINE, SAN DIEGO COUNTY, CAL.,
February 18, 1890.

To State Board of Forestry:

GENTLEMEN: Two years ago you kindly sent me seeds of the Manna and Sugar Gums. I set these out in boxes till they were three inches high; then set some in decomposed granite soil entirely, in which they have done finely, varying now from six to twenty feet in height. I also set some at same time in red soil, in which none are now over three feet, some only two feet.

All were placed on rolling hillsides, without any irrigation. The Sugar Gums are far superior as shade trees, being oval, symmetrical, and beautiful in form. The Manna Gums are too straggling and ragged to make a fine shade tree, but as I have not seen any fully grown cannot judge of them in their fullness. * * * We have a rain belt in this district that gives us more rainfall than in El Cajon, only twelve miles distant. * * * I think your Commission is doing a power of good for this State, and hope it may continue to extend the good work.

Respectfully yours,

DR. H. M. BAILEY.

LOS ANGELES, CAL., November 10, 1890.

W. S. LYON, *Esq., State Board Forestry:*

DEAR SIR: On the twenty-seventh of June last you sent me some young trees, mainly eucalyptus varieties from the station of the Board at Santa Monica, and I now send a short report of progress in accordance with the desire expressed in your letter accompanying them. I received twelve varieties [here follows list].

I planted them out in the form of a small grove after sending about one half to a friend living at some distance from me.

I planted them in sandy loam nine feet apart. Average height of trees when received about nine inches. My place is situated at Glendale, six miles north of Los Angeles. Two each of the *Eucalyptus obliqua*, *E. marginata*, and *E. Stuartiana*, I lost at once. I also regret to say I lost *Eucalyptus eugenioides* and *E. Leuhmani*, of which I received only one each.

The other varieties, however, have done well. At the time of writing and taking the best trees the measurements are as follows: * * * The best growth has been achieved by the *Eucalyptus punctata*, * * * five feet six inches.

I am, also, in receipt from another source of a different gum from any you send.

It is a short, thick-set tree, forming one straight trunk with divided top and throwing out nearly horizontal branches, not drooping, with nearly circular opposite leaves; I inclose herewith a small branch for your inspection, and if you can identify it and name it for me I should be much obliged.

In September I took the opportunity to pay the station of the Board at Santa Monica a visit, and was extremely pleased with the appearance of everything. The foreman (Mr. Southmayd) courteously showed and explained everything to me, and let me have a few more trees to

replace those I lost, and I shall have the pleasure of telling you how this second batch fared in a later report. * * * I shall be greatly obliged to you for any bulletins or reports issued by your office on this most interesting subject of forestry. * * *

Yours very truly,

J. L. WHITTAKER.

PART VII.

FORESTRY BULLETIN NO. 6.

A REPORT ON THE GROWTH OF SOME SPECIES OF EUCALYPTUS IN SOUTHERN CALIFORNIA.

The plantations at the Santa Monica Station, from which the concurrent notes were made, are growing upon a steep hillside having a direct eastern exposure.

The "pitch" is sharp enough to form an angle of 45 degrees to 50 degrees with the plane of the valley beneath, through which runs a small rivulet; the whole plantation, by its location, is protected from strong winds, and is distant from the seacoast about one half mile.

The soil, which is typical of many hillsides in Southern California (and of which analyses are herewith appended), is of two characters: one a grayish clay-like material, thinly overlaid with three to fifteen inches of broken shale, some loam, and a little humus, washed down from a higher plateau or mesa; the other, a reddish mass, bearing a large amount (nearly one fifth) of decomposed iron, and is entirely bare and denuded of any superincumbent covering whatsoever.

For convenience of future reference we will designate the former of these as tract A; the latter, tract B.

The area of both is about the same; tract A was planted January fifth; tract B on January eleventh, of the present year. Neither received any plowing or cultivation of the soil whatsoever.*

Neither has received any water from any source since planting, except rainfall, of which the latest, and then a fair precipitation, occurred March sixteenth.

Growth made between the dates of planting and this rainfall was too inconsiderable for measurement; and at the time of planting the trees measured ten to fifteen inches in height. *Practically*, all the growth noted has occurred between March sixteenth and July thirty-first—a period of four and one half months. The lowest temperature recorded during this time was on February eighteenth, when the thermometer registered 1 degree below zero (30 degrees Fahrenheit). None of the species seem to have suffered from this exposure, although it should be stated that no long-continued low temperatures occurred, 1.10 (about 34 degrees Fahrenheit) being the coldest weather enduring longer, or more continuously, than one night. In many instances such exceptionally good results have followed, and some of the measurements obtainable were so phenomenal, that I feel constrained to record the details above set forth, in order that due consideration may be given to the possible benefits arising from the greater or less atmospheric humidity incident

* A scattered growth of weeds was once cut down; neglect of cultivation was intentional.

to the contiguity of the streamlet and the ocean—the favoring temperature and kindly shelter of the hills from strong winds.

Not only do the analyses show it, but Professor Hilgard, who has kindly interested himself in the matter, assures me that these soils are not anyway deficient in the elemental requisites to successful tree growth. Still, the complete failure of some species, and pronounced success of others under identical external conditions, and adverse ones at that, seems to indicate that where it is not practical to furnish cultivation or irrigation, that by conforming our plantations of forest trees to meet the controlling chemical characters of the soil for which certain species may show assimilative traits, as happy results may ensue as where we can furnish those artificial stimulants to tree growth considered of such vital import to plant life in a dry climate.

The statement of the principle involved, *i. e.*, that plants thrive best where furnished with congenial food, is a bald truism known to every cultivator of the soil, who, if successful, endeavors to fulfill those very conditions in the growing of general or special crops; yet I am unaware that in forest growing its value has ever been suggested, or if so, the suggestion utilized to take practical advantage of conditions as we find them, and without reference to supplying those deficient elements of fertility, either organic or mechanical, essential to general agriculture, and which, applied to forest plantations upon rough and precipitous hillsides, would be expensive, inexpedient, almost impracticable, and probably unremunerative.

Analyses of the soils in question are as follows:

	Tract A.	Tract B.
Insoluble matter	49.948	48.570
Soluble silica	20.730	8.245
Potash (K_2O)	1.093	1.587
Soda (Na_2O)	.658	.853
Lime (CaO)	3.227	8.143
Magnesia (MgO)	2.855	2.450
Br. ox. manganese (Mr_2O_4)	.048	.020
Peroxide of iron (Fe_2O_3)	8.109	18.198
Alumina (Al_2O_3)	6.774	1.569
Phosphoric acid (P_2O_5)	.228	.280
Sulphuric acid (SO_3)	2.648	.733
Carbonic acid (CO_2)	-----	3.180
Water and organic matter	3.597	6.376
Totals	99.913	100.89

Broadly classified, the soil of A is rich in lime in the form of sulphate (gypsum), with a larger amount of readily soluble salts than that of B; and, as compared with the latter, about evenly supplied with potash and phosphates. B, strongly ferruginous, with less of plastic clay than A and its abundant lime in the form of chalk (carbonate).

Digging upon both tracts, July thirty-first, at depths of fifteen to thirty inches, failed to reveal any moisture readily appreciable to touch or sight. Measurements of, and notes of growth of different species upon that date, are herewith given. Heights are expressed in feet and inches, and "average" obtained by measurements "as they ran"—not the mean of the extremes of best and poorest specimens.

Names.	Tract A.		Tract B.		Remarks.
	Best.	Average.	Best.	Average.	
1. Eucalyptus polyanthema (Many-Flowered Gum)	9.6	7	4.2	3.6	Growth in B small but thrifty.
2. Eucalyptus globulus (Tasmanian Blue Gum)	4.6	4	-----	-----	None planted in B.
3. Eucalyptus cornuta	7	6	4.6	4	Sent out last year as the "Tooart Gum," remarkably thrifty in both plantations.
4. Eucalyptus obliqua (Stringy Bark or Messmate)	6	5.6	2	0	Moribund in B. Lacks good color in A.
5. Eucalyptus leucoxylon (Victorian Iron Bark)	5	4.6	5.6	4.6	Richer, better color in the iron soil.
6. Eucalyptus rostrata (Red Gum)	-----	-----	5.6	5	Not planted in A.
7. Eucalyptus corynocalyx (Sugar Gum)	6	5.6	-----	-----	Not planted in B.
8. Eucalyptus viminalis (Manna Gum)	6.6	5.6	4.6	4.6	"Off" color in B.
9. Eucalyptus Stuartiana (Apple-Scented Gum)	6.6	4.6	-----	-----	Not planted in B.
10. Acacia mollissima (Soft Leaf Wattle)	6	5	-----	-----	Not planted in B.
11. Acacia pycnantha (Golden Wattle)	3.6	3	3	2.6	Strongly vigorous in both.
12. Acacia melanoxylon (Blackwood)	2	0	0	0	Sickly in A. Dead in B.

From this tabulation will be noted:

1. That the common Tasmanian Blue Gum, widely recognized as the typical exponent of all that is rapid among forest trees, has (under like conditions) been exceeded by all other species.

2. The general inferiority of all species upon B (as compared with A), with the single exception of the Victorian Iron Bark.

3. The remarkable growth of the Many-Flowered Gum in A, and its *apparent* preference for the gypsum form of lime, rather than the chalk and excessive iron-charged soil of B.

4. The complete adaptability of the Iron Bark to the latter.

5. The utter failure of the Stringy Bark upon B. In this instance—the Stringy Bark—it is not wise to formulate any hasty conclusions, implying want of water or proper nutrition. It is one of the few species making a distinctive tap-root and elaborating few superficial rootlets.

Both of these soils are, in their uncultivated states, strongly impermeable to even water, and the fair success of the same upon A may be due to the slender "top dressing" thereon, and that so soon as its tap-root reaches the densely impacted underlying soil, it may succumb as completely as it has upon B. Despite good growth upon A, it seems to show, in deficient leaf coloring, already an early expenditure of stamina and vitality. Whatever be the cause, its failure is the more regrettable, as in view of the recent tests of the wood of this species made by Mr. Allen Ransome at Chelsea, England. His report* accredits it with the highest value for great strength, toughness, and durability—characters not ascribed to it by previous authors, and, according to von Mueller, it "quickly yields an immense bulk of wood on the very poorest soils."

* Kew Bulletin for May, 1889.

Its adaptability to the poorest soils of California, I think, must obviously be sought upon lands of more porous nature, and hope to continue further experimentation to this end.

All the acacias develop an extensive tap-root, and we are measurably compensated for the failure of the Blackwood by the good showing made by the Golden Wattle. It seems to have found congenial organic conditions that counterbalance the bad physical situation that the Blackwood could not overcome. While the latter makes one of the most serviceable shade trees we know of, the former must come into more general use for forest planting, on account of its pronounced economic value.

To promote an interest in forest growing upon waste lands, where the risks and drawbacks are so considerable, where the initial cost is great, where water nor cultivation is available, vermin destructive and inroads from stock, mountain fires, and other perils imminent, and where final benefits are long delayed; demands that, though we may not assure the planter of any royal road to success, we can at least contribute our quota to minimizing these risks.

None recognize more forcibly than the writer the danger of formulating conclusions from results obtained within circumscribed areas and extending over so brief a time; yet, making due allowance for the value of all climatic appurtenants, I am of opinion that a more careful study of soils and species adapted to them will measurably neutralize these evils.

Not alone do the results here tabulated justify this view, but it is emphasized by noting the unparalleled vigor with which the native evergreen shrubbery grows upon the most arid, forbidding, and inaccessible of our California mountains. Beneath the fiercest of August suns, amongst naked bowlders, and upon almost vertical acclivities, and where the little soil obtainable at any depth accessible to tree roots is practically anhydrous dust, *Prunus ilicifolia*, *Heteromeles arbutifolia*, and various *Rhus* will be found to expand in generous profusion their wealth of luxuriant flowers and foliage—an ever present lesson that fundamental elements of success with other trees are not lacking if we well and wisely utilize the material at command.

WM. S. LYON,
Forester.

LOS ANGELES, CAL., September 1, 1889.

PART VIII.

MEMORIAL.

California State Board of Forestry to the Congress of the United States:

To the people of that portion of the United States inhabiting the so called arid districts, or those States and Territories visited either with scanty or only periodical rainfall, there is no single question that so profoundly affects their material welfare and future prosperity as that of a copious and enduring water supply for domestic, mining, and irrigation uses. Any conditions which result in impairing even slightly the supply now obtained in these districts, must be viewed with apprehension—any MATERIAL decrease in some of the affected localities would imply a shrinkage of millions of dollars in taxable values; while FAILURE of present supply would involve in business paralysis and financial bankruptcy some of the fairest and most thriving sections of the great Southwest. The continued progress and future development of large portions of Colorado, New Mexico, Nevada, Arizona, and, above all, California, seems to be only limited by this question of water supply, and it would appear to be a fair field for Congressional action to inquire into causes threatening its diminution, and by wise remedial measures preserve the integrity of such as we have, and promote wherever possible its further increase and usefulness.

Recent investigations of the Senatorial Arid Lands Committee have shown that irrigation, wherever practiced, has resulted in phenomenal benefits to people fortunate enough to come within the scope of its operations.

In California the vast area of the Sacramento-San Joaquin Valley (greater than the State of New York) is rapidly becoming opened up to settlement and profitable occupation, chiefly through the agency of elaborate and costly systems of irrigating canals. The more southern end of the State owes its surprising industrial advances more to the successful artificial distribution of a naturally limited water supply rather than to especial climatic or geographical advantages.

River bar and placer mining, as is generally known, can only be profitably prosecuted where water is abundant, and great numbers of paying properties throughout the west coast are unoperated and rendered unproductive during many months of the year, not so much from the inadequacy of the supply as from the existence of partially remediable conditions which prevail to quickly exhaust the fountain head.

The source of the water now enjoyed by the miners and agriculturists of this coast is found in rivers, streams, and springs having their inception in the timber-covered slopes and crests of the Sierra Nevada Mountains and its spurs.

Upon credible information, we believe that at points upon Kings, Fresno, and the Merced Rivers, above where any waters are withdrawn

for irrigation or mining purposes, that in so called "dry years" there is already a marked diminution in the volume of their waters over past "dry years," and prior to the wanton deforestation of the brush and timber-covered slopes of their watersheds.

From personal observation we know this to be true of the Feather River, and believe that the same causes that threaten the mining, agricultural, and horticultural interests of this State are insidiously, but unerringly, at work to imperil and undermine the inland river commerce of our navigable streams, the Sacramento and San Joaquin Rivers. Unfortunately, the ownership of much of these timbered lands has passed into private or corporate hands; and we say *unfortunately* advisedly, as it seems impossible to impose any forcible restraints that shall altogether do away with wanton and wasteful destruction of timber by fire and the ax, or the pasturing out of their forest reproductive character by persons unmindful of the future and heedful only of considerations of immediate gain to themselves.

Nevertheless, there still remains of the brush and timber-covered watersheds of the Sierra Nevadas, and comprising those portions upon which the very life blood of the industries mentioned depend, millions of acres of surveyed and unsurveyed lands the ownership of and fee simple to which lies in the Government of the United States alone.

The custody of these lands at present is in the Department of the Interior, and, as part of the nation's heritage, and of incalculable value to the people of this country, they demand as careful stewardship and wise management as do the moneys in the public treasury.

A circular of the General Land Office of date of March 8, 1883, calls for the posting on the public domain of notices warning against the setting out of fires; yet such notices over eight hundred miles of this State are not posted, nor can records be found of arrests or prosecutions within this State by Federal officials for such offenses. All such action has heretofore been carried out by State authorities, hampered by feeble laws, limited means, and a territory to supervise nearly as vast as the whole Atlantic seaboard.

No further effort seems to have been made to arrest the obliteration of our forests from mountain fires, or to check the still more blighting and disastrous spoliation of their young growth by nomadic flocks of sheep.

Conscientious and rigorous measures have been fully carried out by the department to bring to justice trespassers upon these domains, who have cut and stolen timber and fuel therefrom; yet the value and volume of all the timber and fuel that has been stolen from the public domain in California for twenty years past, is insignificant as compared with the standing timber and young forest that is annually swept away by the combined evil agencies of fire and sheep.

If a tithe of the money and energy applied to the abatement of the lesser ill had been brought to bear upon the suppression of the greater one, the evil of which we now complain would not have grown to such monstrous and appalling proportions. The unprotected and unguarded condition of the nation's forest is a constant menace to freeholders and occupants of adjacent lands, and the newspaper press of the whole country during recent months has recorded innumerable disasters to both life and property from fires having their origination upon the public domain; and even if no considerations of self-interest intervene, the sovereign

ought not to be held unaccountable for its own laches when they result in death and disaster to the subject.

It is here assumed that the water-storing character of forests is too well known and conceded to admit of either elaboration or argument upon that point; and that the danger from flood and freshet incident to their indiscriminate removal is as generally known as it is freely recognized; nevertheless, to the people of the Pacific Coast, forest preservation has another aspect of the gravest import to them, and not necessarily a factor of equal moment in all forestal questions.

Environed on the south and southeast by an arid, treeless district, almost uninhabitable by reason of its torrid summer heats, the people of the adjacent territory can only look upon the possible enlargement and encroachment of this inhospitable region with profoundest apprehension. Their immunity from invasion by this hostile climate depends upon the great forests of the northwest coast, whose benign, ameliorating, and far-reaching influences alone enable them to maintain the unequal contest with greater forces. The diminution, recession, and final and threatened extinction of these forests must only result in the expansion and aggression of elements inimical to our well-being, fatal to our prosperity.

II.

Recognizing the difficulties of formulating forest protection laws that offer a solution of all objections that can be framed, the California State Board of Forestry tenders some suggestions in this direction that it is believed will meet the exigent demands of the mining and agricultural classes, nor yet be antagonistic to the great lumbering or live stock industries of this State.

First—Extreme urgency demands the temporary repeal of the timber entry law in California, and the absolute withdrawal from sale of all Federal timber lands in this State, until future surveys have determined the areas and boundaries of such tracts as are contained within the natural watersheds of our streams and waterways. For obvious reasons, the restrictive feature of the Act must operate prior, not subsequently, to the making of the surveys; otherwise the door is still open for some years for the perpetuation of the injury we would have abated.

Timber lands not so situated could ultimately be reopened for sale or occupancy, though no really valid reason can be adduced to show why this repeal should not be in perpetuity, and that *all* Federal forest lands, irrespective of their watershed or non-watershed character, should not be alienated to the people at large and from the individual forever.

Such a course will conduce not only to the benefit of the individual, but to the Government as well. A forest, or timber, like any other crop, when mature is fit to harvest, and when not subject to wasteful abuses may with propriety and benefit be cut; when, however, to facilitate access to a tract, vast quantities of intervening lands are laid waste and valuable timber is left to decay and destruction, then such methods become improvident and should be rigorously suppressed. In most instances these outrages are perpetrated upon the public domain, and are as defensible as would be the acts of a farmer in burning the fields and breaking down the fences of another for the purpose of securing a more expeditious route to market.

Second—The timber on such lands, when fit to harvest should be sold, not the land.

The lumberman, as a rule, cares nothing for the land; in buying forest he is only influenced by the number of feet or saw logs to the acre, and consequently will pay as much for the timber alone as he will for the land and the timber; hence, in selling the timber alone there is no loss of revenue to the department, while the fee remaining in the United States, they can impose such reasonable regulations for the preservation of young growth and the prevention of fires as will not alone insure the perpetual forest character of these lands, but yield in the future further returns of revenue.

Young growth forest lands for some years after the timber has been cut affords the best of pasturage, and, when the trees are of sufficient size, can be pastured to cattle, and even sheep, without injury; and the rentals derived from the same would, in a few years, more than meet the charges of guarding them from vandals and freebooters.

Accident of ownership by the United States seems to have operated to cause owners of errant flocks and herds of sheep and cattle to think they have some rights to pillage and plunder the public domain, reserved to themselves and denied to those engaged in other pursuits.

The successful prosecution and conviction of a few timber thieves has operated to almost abate the once thriving enterprise of lumber stealing. The same process, vigorously enforced, would doubtless mitigate the theft of pasture, and the far worse and almost invariable sequel of forest fires.

These lands, to be preserved to the interests of agriculture, mining, and lumbering, will require a systematic supervision and minute attention to executive detail not necessarily pertinent to the rest of the public lands, and which would tend to embarrass the already overloaded and complicated machinery of the General Land Office.

Hence, the propriety of assigning the custody of them to the Department of Agriculture under a competent Commissioner or Commissioners—to a department already equipped with a Division of Forestry, and under which they could be so administered as to become a source of national pride and wealth. If it be contended that the retirement of so much of the public domain is not in accord with the policy of our Government, we suggest that this loss can be offset by wise efforts to expand the benefits of the Timber Culture Act; the time for "proving up" can be extended, and to those who plant timber upon otherwise unproductive grounds, immunity from taxation for all time upon lands consecrated to this purpose.

The principle which would justify such legislation lies in the fact that the planter becomes a public benefactor, and that long before any direct profit can accrue to him benefit has inured to the whole commonwealth by his act.

Aside from persons who have availed themselves of the Timber Culture Act of 1878, are many individuals and corporate owners of large tracts of mountain and upper foothill lands unsusceptible of irrigation or cultivation; hence, unsuitable for agricultural uses and only available for grazing or forest plantation.

Would-be planters of such tracts are largely deterred from so doing through want of authoritative information as to the character of timber best qualified to thrive thereon, and under such conditions to yield the

best final returns. All legitimate encouragement should be tendered those willing to engage their time and means in enterprises calculated to so largely redeem the arid character of much of this country.

This encouragement is best promoted by the establishment of forest experiment stations in the most arid districts of Colorado, California, Nevada, and Arizona, and while their educational value be indisputable wherever established, the practical and material necessity for their existence is most strikingly emphasized in those States and Territories dependent upon seasonal rains, or subject to periods of long protracted drought.

Properly belonging in the jurisdiction of the Department of Agriculture, such stations obviously must be independent of, and remote from, agricultural experiment stations. These latter are (and properly) conducted upon lands fitted for cultivation. The former must be upon grounds typical of the millions of acres of to-day waste lands of the arid Southwest.

Public-minded citizens tender ample lands for such purposes free of cost to the Government. The initial cost of planting them out will not be great, and the subsequent cost of maintenance will be in a constantly diminishing ratio until they ultimately become self-supporting or a source of revenue to the State.

The present administration, or rather want of administration, of the Federal timber lands of this coast, is an arraignment of the best intelligence and patriotism of the general Government, which a disregard of the enlightened methods of other nations might not alone challenge, but which a due regard to ourselves and posterity does, and which strenuously and exigently calls for reformation and remedial measures that shall check the impending menace to our immediate and future prosperity.

The active and earnest coöperation of the California State Board of Forestry can at all times be relied upon to supplement and forward such action as Congress may take.

WALTER S. MOORE, Chairman.
JOHN D. SPRECKELS.
FRANK J. MOFFITT.

WM. S. LYON, Forester.

VALUE AND DESCRIPTION OF LUMBER EXPORTED FROM JULY 1, 1887, TO NOVEMBER, 1890.

The annexed table, condensed from the records in the Custom House, shows the value and kind of all lumber exported from the port of San Francisco for forty-six months ending October 31, 1890:

Date.	Laths.		Shingles.		Shooks—Value.
	Thousands.	Value.	Thousands.	Value.	
July 1, 1887, to June 30, 1888	519	$2,616	12,667	$25,498	$13,434
July 1, 1888, to June 30, 1889	380	1,511	9,132	15,562	15,732
July 1, 1889, to June 30, 1890	-----------	-----------	7,728	12,464	29,770
July 1, 1890, to Nov. 30, 1890	152	690	3,461	5,193	9,783

Date.	Staves—Value.	Lumber O.—Value.	Lumber Sawed.		Lumber Hewed—Cubic Feet.
			Thousand Feet.	Value.	
July 1, 1887, to June 30, 1888	$244	$17,491	15,911	$428,008	-----------
July 1, 1888, to June 30, 1889	1,306	80,107	20,148	487,387	130,356
July 1, 1889, to June 30, 1890	-----------	60,682	18,944	430,782	113,218
July 1, 1890, to Nov. 30, 1890	-----------	18,973	7,399	116,313	1,847

Date.	Lumber Hewed—Value.	Doors, Sash, etc., and Stock—Value.	Moldings—Value.	Furniture—Value.	Wood Used—Value.
July 1, 1887, to June 30, 1888	-----------	$136,879	$19,014	$152,249	$66,159
July 1, 1888, to June 30, 1889	$43,900	97,788	14,168	163,579	53,117
July 1, 1889, to June 30, 1890	27,270	90,239	11,135	180,608	63,529
July 1, 1890, to Nov. 30, 1890	650	40,119	2,927	63,709	21,368

Of the foregoing quantity there was exported:

To Australia	37	per cent.
To Mexico	15⅔	per cent.
To England	13	per cent.
To Ireland	9	per cent.
To Hawaii	8	per cent.
To Guatemala	7	per cent.
Total	89⅔	per cent.

The remaining 10⅓ per cent was exported to Brazil, Costa Rica, Peru, Honduras, San Salvador, Chili, China, Ecuador, France, British Columbia, Hong Kong, Japan, U. S. of Colombia, and other countries.

San Salvador stands next in order below Guatemala, and took approximately 3 per cent, leaving 7⅓ per cent for the remaining countries.

The sawed lumber for England and Ireland goes as dunnage in wheat ships. Each vessel taking any, receiving about twenty thousand feet.

England is the largest importer of hewn logs from the port of San Francisco.

REPORT OF THE BOTANIST

OF THE

CALIFORNIA STATE BOARD OF FORESTRY,

J. G. LEMMON.

LETTER OF TRANSMITTAL.

LEMMON HERBARIUM,
1015 Clay St., Oakland, Cal.

To the California State Board of Forestry: Walter S. Moore, Chairman; John D. Spreckels, Treasurer; Frank J. Moffitt; Sands W. Forman, Secretary.

GENTLEMEN: Herewith I have the honor to submit my Second Biennial Botanical Report upon the Forest Trees of the Northwest, particularly of California; this report treating exclusively of the Coniferæ, or Cone-bearers.

My report embraces four principal parts: First, introductory papers upon the origin, development, distribution, and extinction of species; the dominance, completeness, analogies, and fundamental characters of surviving species, concluding with classification, general and special, and classified lists showing the present locality and strength of the Cone-bearers, especially of the Northwest development.

The second part contains extended descriptions of the Cone-bearers wherever distributed, for the benefit of comparison, leading up to the particular discussion of those in the Northwest forests, treating the widest distributed, strongest species first in each group or genera, concluding with the most local, limited, and perhaps expiring species. This division necessarily comprises the greater part of the report.

The third part contains papers on forestal subjects of a general character, forests and rainfall, usefulness of snowdrifts, etc.

The fourth part comprises six map schemes of vegetable development and classification. Attention is called to this new method of presenting to the eye the correct position of the Cone-bearers in the cyclical impulsions of the vegetable development, the characters upon which they subsequently divide into classes, and eventually into genera and species; the strongest, best fitted strains in each case becoming uppermost and farthest advanced, with the related currents or lines of development halting behind on either hand, at unequal distances.

Finally, the whole is accompanied by ten full-page illustrations of mostly entire trees characteristic of California Cone-bearers, and twenty illustrations of branches, cones, scales, seeds, leaves, etc.—being thirty illustrations in all—copied from Mrs. Lemmon's paintings or from elaborated botanical specimens mounted and displayed upon large exhibition cards, for the purpose of supplying the means of certainly identifying species and varieties discussed in this report; the artotypes are by Britton & Rey, San Francisco.

Thus it has been the desire of the writer, and his associate, to present a treatise upon our noble forest trees that shall be scientifically correct, and measurably exhaustive of the subject treated, while it may be, at the same time, free enough of technical, unexplained botanical terms, to become easily comprehended by the general public, and paramountly, to enable Californians to become better acquainted with, and properly

appreciate our numerous and magnificent forest trees—most of which are evergreen Cone-bearers.

ACKNOWLEDGMENTS OF AID.

Important assistance has been rendered us by a large number of persons and corporations in the prosecution of our researches and the collection of specimens, materials, statistics, determinations, etc.

Foremost of all is the acknowledgment of paramount indebtedness to the Directors and other officials of the Southern Pacific Company, who have given every facility for transportation over their numerous lines of railway; for it is freely admitted that little could have been done without their signal aid to persons of limited means while attempting to explore so vast a region as the Pacific Slope, with its many special forest headquarters so widely and peculiarly separated.

Similar assistance has been given us by the California and Oregon Railway Company; the Oregon Railway and Navigation Company; the Northern Pacific Railway Company; the San Francisco and North Pacific Coast Railway Company; the Atchison, Topeka, and Santa Fe Railway Company; the California Southern and the California Central Companies; also, by the Pacific Coast Steamship Company; the Pacific Improvement Company, and by the proprietors of several stage and transportation companies.

Important assistance in the discussion of certain mooted questions concerning the *Sequoia gigantea* has been rendered by the distinguished Old World authorities in botany, Prof. Alfonse De Candolle, Sir Joseph D. Hooker, and Dr. Maxwell T. Masters, extracts from whose letters are freely quoted in the discussion; also, by the American botanists, Prof. Thomas Meehan, Dr. J. S. Newberry, Prof. C. S. Sargent, Prof. Sereno Watson, and Prof. L. F. Ward, whose several thoughtful publications have elucidated many of our forest problems.

Important assistance has been received from our eminent geologist and philosopher, Prof. Joseph Le Conte, especially in questions of evolution and classification; and from the distinguished botanist, Prof. E. L. Greene, upon questions of authority and precedence, determined by reference to rare old books in his library and that of the State University.

The late Dr. C. C. Parry, the noted explorers John Muir and Dr. Edward Palmer, also President Harkness and T. S. Brandegee, of the California Academy of Sciences, together with the following other noted botanists, have rendered important assistance:

Dr. C. L. Anderson	Santa Cruz, Cal.
Prof. H. N. Bolander	Portland, Oregon.
Prof. L. F. Henderson	Portland, Oregon.
Dr. O. P. S. Plummer	Portland, Oregon.
Rev. Ernest C. Smith	Seattle, Washington.
Charles V. Piper	Seattle, Washington.
S. B. Parish	San Bernardino, Cal.
R. L. Fulton	Reno, Nevada.
C. F. Sonne	Truckee, Cal.
Daniel Cleveland	San Diego, Cal.
Mrs. Jennie N. Hughes	San José, Cal.
Mrs. Mary E. P. Ames	Auburn, Cal.
Mrs. R. M. Austin	Davis Creek, Cal.

Special acknowledgments of assistance are hereby tendered to the following enterprising citizens of the Pacific Slope, who have aided us in

various ways during the arduous field work of the last season, or of preceding seasons' explorations:

Kimball Bros.	San Diego, Cal.
J. S. Taylor and family	Del Mar, Cal.
Gov. R. W. Waterman	Waterman Station, San Diego County, Cal.
Mrs. Jeannie C. Carr	Pasadena, Cal.
H. B. Muscott and family	San Bernardino, Cal.
John Nelson	Tehachapi, Cal.
Ellwood Cooper and family	Santa Barbara, Cal.
H. C. Ford and family	Santa Barbara, Cal.
John Spence and family	Santa Barbara, Cal.
Mrs. R. F. Bingham and family	Santa Barbara, Cal.
Dr. Lorenzo G. Yates	Santa Barbara, Cal.
E. W. Steele and family	San Luis Obispo, Cal.
P. W. Murphy	Santa Marguerita, Cal.
S. M. Dyer and family	Starkey, Cal.
W. R. Rockwell and family	Starkey, Cal.
W. F. Brown and family	Cholame, Cal.
Mrs. M. H. Field and family	San José, Cal.
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John Myers	Monterey, Cal.
Mrs. E. H. Thomas	Pacific Grove, Cal.
Dr. J. G. Cooper	Haywards, Cal.
B. Frank Lemmon and family	Sierra Valley, Cal.
W. C. Lemmon	Sierra Valley, Cal.
Peter Oleson and family	Sierra Valley, Cal.
Prof. E. L. Case	Downieville, Cal.
W. F. Peters and family	Tahoe City, Cal.
J. H. Moody	Truckee, Cal.
M. Lawrence & Co.	Tallac, Tahoe City, Cal.
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J. H. Sisson and family	Sisson, Cal.
J. M. Hutchings	Yosemite, Cal.
Mr. and Mrs. E. C. Williams	Oakland, Cal.
Rev. Robert McLean and family	Grant's Pass, Oregon.
Malon W. Wheeler and family	Grant's Pass, Oregon.

The field work and collections were supplemented by historical data and determinations derived from latest botanical publications, from extensive correspondence, and in part from the use of the libraries of the State University, the State Library at Sacramento, the Mercantile, Mechanics', Odd Fellows', and Public Libraries of San Francisco, Oakland, and several private libraries, in short, wherever information could be found of value as bearing upon the subject-matter of the accompanying report.

All of which is respectfully submitted.

JOHN GILL LEMMON,
Botanist California State Board of Forestry.

August 30, 1890.

CONE-BEARERS OF CALIFORNIA.

PART I.—INTRODUCTORY PAPERS.

INTRODUCTION.

In the Second Biennial Report of the California State Board of Forestry, for the years 1887 and 1888, I discussed in a general way the Pacific Cone-bearers, giving the climatic conditions that cause the growth of forests generally. It was shown that most of our forests depend primarily upon the two great warm ocean currents that bathe the northwest coasts of Europe and of America, supplemented by the direction given to the atmospheric currents crossing them and then striking against the land surface, especially of mountain ranges.

It was shown that the American forests were the larger of the two regions, and that the interrupted coast and archipelago of the Northwest, by receiving and delaying the *Ku-ro-Si-wa*, or Japan current, had located the headquarters of this great forest development in the vicinity of Puget Sound, while the higher moisture-bearing winds escaped farther inland, and produced the magnificent forests of the Cascade and Sierra Nevada Ranges.

It was shown that the principal part of these forests was composed of cone-bearing trees, comprising fourteen genera of seventy-eight species, all told. A brief synopsis was given of these, and a table showing their distribution.

The leading and large family of Pines was then selected for description in that report, and its eighteen California species were classified upon their fruit characters, and then described in detail, with illustrations of the principal species, their diverse cones, flowers, leaves, seeds, etc.

The discussion embraced a special investigation of the two most important lumber Pines—Sugar and Yellow Pines—with short papers upon "Renewal of Pines," "Pines in Literature," "Pines of America," etc., concluding with the "Diagnosis of the Genus Pinus," for the closer student of the subject.

Readers interested in the "Pines of the Pacific Slope" are respectfully referred to the report cited above.

REPORT FOR 1889 AND 1890.

In the present report descriptions of all the Cone-bearers—excepting Pines—will be attempted, and it is to be regretted that the localities where some of them grow at their best could not be visited last season for fresh facts, owing to the unprecedented early summer fires, followed soon after by much earlier autumn rains than usual. Added to these obstacles to effective exploration was the further misfortune that most of the annual-fruited Cone-bearers failed to bear fruit the past season, including most of the Spruces and Firs.

The description of our California conifers involves a deeper, more extensive discussion of their origin, development, distribution, persistence, and relations than was at first contemplated. The California flora at

once is seen to be not alone and distinct, but as part of an extensive and prodigious development peculiar to the Northwest, and with which it must be considered.

An idea of any given species, to be intelligible, must be compared with that of its relatives, and these may be now—most of them—removed from the earth, or they are separated by space, it may be half the circuit of the earth, or by longitude in the same region, or again, by altitude in the same mountain.

Lastly, several species may be associated in precisely the same locality, yet be separated by cross-sterility resulting in wide differentiation.

In the presentation of species, origin and development are of first importance. Lines of development are early instituted, and they are conceived to be upward and onward, like vapor rising from the earth, a bird taking its flight, or a strong man commencing a journey.

This development is interrupted by great changes in the temperature of the earth, a cold one, called the Glacial Age, causing universal migration from the north; a subsequent warm one causing an attempt to return, resulting in separation, dispersion, isolation, and wholesale destruction.

Present species are then seen to be but remnants of extensive families, the surviving members more or less dispersed over the earth.

In discussing present forms of plants—existing species—the farthest removed will, for convenience, be briefly considered first, leading up to the western development, and when the great West is reached, the widest distributed, strongest species first, ending with the most local, weak, and, perhaps, expiring species.

In descriptions an attempt is made to give the characters correctly, but in familiar language. The nomenclature necessarily engages much attention, and an attempt is made to keep abreast with the times and the latest discoveries both of species and of the earliest descriptions of them. The law of priority is recognized and rigidly enforced, although, in some instances, it causes the dropping to a synonym (inclosed in parentheses) of a name endeared by long familiarity, and the substitution of one not new to science but to the general reader.

The determination of some of these "new names" is often brought about by consultation with eminent authorities, extracts from their recent letters being freely quoted, especially in the settlement of the botanical name of our Redwoods. In other instances, names are revived and given to forms that once bore them, on the principle that different things are entitled to different names, provided the difference is fundamental, or comprising several important particulars. Lastly, new names are coined for genera, species, and varieties newly elaborated.

POPULARIZING SCIENTIFIC NAMES.

In the preceding report the statement was made that the Board of Forestry had commenced the great work of popularizing scientific descriptions of our forest trees, illustrating them also, so that even an amateur is enabled to recognize the species. Correspondents from abroad and at home assure the writer that this has been accomplished in the case of the Pine family, so we are encouraged to continue the work with the rest of the Cone-bearers.

Unlike the inhabitants of northern Europe, whose veneration for Linnæus causes them to readily learn the accurate scientific names he

gave to plants, the average American rarely tries to learn the Latin names, scouting them, perhaps, as too pedantic, and often persisting in manufacturing misnomers.

This practice leads to ignorance or worse—gross error from the use of a name loosely applied to a dozen different species. In descriptions following, as few technical terms are used as possible consistent with accuracy, and they are defined by familiar words when first used.

The reader is earnestly requested not to skip or hesitate when encountering an unfamiliar word, *but to at once pronounce it and make it familiar*, remembering that in the Latin there are no silent letters—every one has its proper sound. So, in reality, the botanical names are easily pronounced, and thus a correct knowledge of our trees may be readily gained by the largest class of readers through the exercise of a little resolution and perseverance.

Already many citizens find no difficulty in saying *Sequoia gigantea*, when alluding to the Sierra Big Tree; or, *Pinus ponderosa*, for one of our lumber pines; or, *Quercus agrifolia*, for a certain field oak, etc. A little attention to propriety and clearness would rectify much misnaming of trees, and would result, at last, in uniform usage of suitable vernacular names (as given in connection with the trees in following pages), and soon would follow the gradual adoption of the only really distinctive appellation, the term of last resort when one wishes to be sure of avoiding ambiguity, *i. e.*, the technical, usually euphonious, easily pronounced botanical name.

CONIFERÆ, OR CONE-BEARERS.

The cone-bearing trees comprise the families of Pine, Fir, Spruce, Larch, Cedar, Redwood, Cypress, Arbor-vitæ, Juniper, and the allied small families of Yew and False Nutmeg, embracing fourteen genera (omitting the Cedar) and forty-six species within the limits of California.

In order to discuss such a large number of species intelligently, and to retain the impressions sought to be conveyed of them, it will be helpful to resort to methods of presentation that become object lessons to the eye.

Conceiving that the natural development of vegetable growth is upward and onward, and that we are chiefly concerned with the surviving, ultimate families, in the order of their prominence, we shall have frequent occasion to refer to the accompanying "schemes," designed to assist in presenting the development, first, of the whole vegetable kingdom, thus showing the place of the Cone-bearers and their relative importance, then taking such lines of development as concern us, and presenting them anew with their ramifications.

It will be noticed that the *Coniferæ* lead in the great class of GYMNOSPERMÆ, and that the Pines are the chief family of these, so we have commenced aright in describing these Pines first in the former report.

The history of the group of "Pitch Trees," including the Pines, must be briefly touched upon again, as it leads up to the special descriptions of Spruces, Firs, etc.—the especial burden of this report.

ANCIENT HISTORY OF THE PITCH TREES.

The many references in the writings of the ancients to the pitch tree, as in the Psalms of David, doubtless allude to the trees of the Bible countries, now known to be members of the Spruce and Fir families.

Pliny, the Roman naturalist, living in the early years of the first century of the Christian era, had good knowledge of the pitch trees of his vicinity, and wrote of them:

"Whereas, in Asia there are several trees that produce pitch, in Europe there are but six."

In one of his thirty-six books on Natural History, he names and describes these six pitch trees substantially as follows:

1. *Pinus.* Pine, *i. e.*, the true Pine (*P. pinea*). Even in Pliny's time much cultivated in Europe.
2. *Pinaster.* Literally, "pine-like;" afterwards known as a True Pine (*P. sylvestris*), but then called "Wild Pine."
3. "Torch Tree." "Gives out more pitch than either of the others." (*P. Cembra*); not then known as a kind of Pine.
4. "Pitch Tree." Trees believed to be species of Spruce, as we now limit the term.
5. "Fir Tree." Trees "with full branches." Doubtless a species of Fir, and quite accessible to Pliny.
6. *Larix.* "Casting its leaves before winter." A species of Larch, or, as it is called in America, "Tamarack."

"All these trees," Pliny states, "are evergreen" [not so the Larch] "and not easily distinguished."

The ancients, for want of systematic methods of classification, which came on later, were unable to detect the groups of characters that are now well known as separating the pitch trees into their families; so in the Greek and Roman classics they are all included in the reference to *Pitys* or *Pinus*, and usually refer to the most common pitch trees known to the people.

Those trees heard of in the mountains, and reported by hunters or devotees to the shrines of the mountain deities, were merely called by some name meaning "Wild Pitch Tree." It happens that it is of these wild, little known trees, then, that we shall have most to do, and their western relatives to describe in these papers.

Tournefort, in 1700, was the first to clearly describe the pitch trees and to distinguish them into the five following genera as they stand to-day: *Pinus*, *Picea*, *Abies*, *Larix*, and *Cedrus*.

Linnæus, fifty-three years later, in his SYSTEMÆ NATURÆ, crowded these genera all back into one genus as *Pinus*, while other families of *Gymnospermæ* found other places in his artificial system along with euphorbias, sterculias, and others.

Nearly a hundred years later, Bongard in 1834, Don 1835, Link 1841, Spach 1842, Loudon 1842, Endlicher 1847, Carriere 1855, Gordon 1858, and Parlatore in 1868, reclassified and redescribed the pitch trees, or Cone-bearers, each scientist doing something at eliminating the Pines from the rest, and each from the others, arriving ultimately at the same classification, substantially, that Tournefort had reached a hundred years previous.

The ante-Linnæan botanists clearly distinguished the genera *Picea* and *Abies*, placing Spruce in the former and Fir in the latter genus, but

by some inadvertence, perhaps, Linnæus, the great law-giver in botany, reversed the terms, and the confusion thereby created in botanical nomenclature has continued to the present time, and to-day the most distinguished authorities on both continents are opposed in the use of these two terms.

Chief of those who apply the name *Abies* to the Fir family are all the older botanists, including Pliny and Tournefort, with the moderns, Link, Spach, Carriere, Michaux, Nuttall, etc.

Chief of those applying the name *Picea* to the Fir family are, first of all, Linnæus, then Don, Loudon, Gordon, Emerson, etc.

As late as 1847, that close student of *Coniferæ*, Endlicher, still classed both the Spruces and Firs with the Pines, and as late as 1856, Dr. Asa Gray, in his "Flora of the Northern United States," arranged the Spruces as a sub-genus of *Abies*, under the name *Picea*.

And this confusion of the botanical names was communicated to the popular names as well, and still continues—well informed persons calling a tree a Spruce, which another calls Fir, according to their training.

Dr. George Engelmann, than whom no one in recent times has devoted more labor to the study of our trees, in his exhaustive publications in 1880 wrote: "I follow Link in his definition and limitation of the genus *Abies*, which seems to be a very natural one, comprising the Silver and Balsam Firs. The name *Picea* enjoys the Linnæan prestige, but is contrary to Pliny's and to classical usage. *Picea* is the Pitch Tree, and properly designates the Spruces. Tournefort, the elder De Candolle, Gray, and others comprised under the name *Abies* both the Spruces and Firs, "but," the doctor declares emphatically, "the generic distinctions between them are abundant and based upon floral and fruit characters as well as upon the leaf anatomy."

NOTE.—The leaf anatomy, the peculiarities of which as distinguishing genera and species of the Cone-bearers, is the discovery of Dr. Engelmann, was largely relied upon by him for his primary classifications; but as the leaves are small and their organs microscopic, their study must be relegated to the close observer; hence, these leaf-characters, however constant and distinguishing, must be neglected in a treatise designed for the general reader.

We offer, instead, classifications based upon plainly evident characters—chiefly the fruit, or, as it is commonly called, the cone or bur. In the illustrations, however, cross-sections of the leaves of certain species are shown, where the characters are important.

DEVELOPMENT THE BASIS OF CLASSIFICATION.

DIVERSITY AND WARFARE.

If the earth were a flat, plane, smooth, stable surface, and if it were equally illuminated at all points from the same direction, and further, if it were evenly watered throughout, then there could be but one form, or at most but a few forms of plant or animal existence upon it.

But as we have a globular, swift-revolving, much-inclined, far-traveling, and withal, a slow-maturing and turbulent planet, the conditions are vastly different from the first supposed case.

Our little globe was condensed out of the attenuated matter of universal space ages upon ages ago, and commenced whirling through space while it condensed, solidified on the surface, cooled down to a low tem-

perature, became wrinkled and old, blistered and erupted long before it was fitted for the production of living individual objects as we now know them.

All we comprehend of the infinite productions of the earth, all we experience of intricate relations, of diverse conditions, results from the modification of a few primitive types of being that originated when the world was young, smooth-faced, and mild-tempered, not as now—old, shriveled, sculptured by glaciers, upheaved in sections by confined vapors, while other portions are being submerged by oceans, etc.

The vicissitudes incident to world growing, to planet development, compelled changes in the forms, the aims, the habits of its inhabitants, that each type of being might live, thrive, and perhaps survive others, until each type in its turn was overcome and borne down by the hardships of its environment, or the superior power of its enemies, yet not before each type had acted his part on the stage of being; each fulfilled his mission—that of giving expression or embodiment to a certain principle or divine idea that in some degree has advanced a line of development toward a to be perfected state.

The individual expressions of these lines of development, these plants and animals, so called, introduced at first under favorable conditions in an open field, while the earth was smoother-faced, have later been jostled and huddled together, so to speak, by upheavals and lapses, by alternations of heat and cold, by migrations and dispersions, while each retains its instinctive determination to exist.

Here begins the warring phenomenon, the contention, fierce unto death, that pervades all animated nature. The individual expressions of every line of development thrust into the pasture fields of other types, at once begins the warfare; each must battle or suffer, must conquer or yield, contending constantly, with eternal vigilance, for standing room, for vantage ground.

And this conflict, begun with the birth of organic life, must continue down to the end of time, as we say, that is, until the globe has completed its growth, has become, as it were, a cinder, its vital forces exhausted and all its expressions of life departed.

This warfare, pro and con, is waged by means of implements of attack and defense innumerable, and when we, intellectual, conscious beings, begin to think about our neighbors, and try to classify them, we are often greatly confused. We find all manner of strategical measures resorted to, all kinds of disguises, similitudes, compromises, innovations—anything to obviate a surrender or to conquer a foe in order to adapt one's self to circumstances for one's own betterment.

When we are examining an object or a group of objects, seemingly separated from or united with others by important characters, either in respect to their degree or their number, it often happens that the separation or union is one of appearance only, owing to our ignorance of related objects—those being discovered in time perhaps, after diligent research.

Also, it often happens that so called very distinct species or genera appear so simply because their relatives have been withdrawn from the earth, have gone down in the struggle and become extinct.

For example: within the limits of the United States there are now but about one hundred and sixty recognized species of Ferns; but the coal-measures of the same region—the rocky albums of Nature—when

opened reveal over three hundred and eighty extinct species. The same remarks may extend to other natural objects, notably the insects, three or four times as many of which have been withdrawn from the earth as are now flourishing upon it.

WITHDRAWAL OF SPECIES.

Among the most notable examples of the withdrawal of species are some that especially concern us in this discussion of forest trees.

The Redwoods, as we know them, are colossal giants of the vegetable kingdom limited to the narrow confines of California, but in two very different climatic regions; the one on the low, moist coast, the other in the high, cool Sierra region.

The researches of the geologist, revealing the paleo-botany of the earth, have detected some twenty-four more species of Redwood in the rock albums of the earth, while nearly as many more forms of *Magnolia*, *Taxodium*, and of *Libocedrus* are known to have existed abundantly in Miocene times, and in extremely northern latitudes (notably Greenland and Alaska), the earth then being very warm, with no polar ice.

All but a few solitary remnants of these species are now extinct.

THE GLACIAL EPOCH, CAUSING PLANT DISTRIBUTION AND EXTINCTION.

The last, most important, and comparatively recent event that followed the changes in the temperature of the earth, resulting in the general migration of species, the extinction of most of them, and the dispersion of the rest, is known as the Glacial Epoch, or Era of Ice, which occurred in Pliocene times (*i. e.*, the last age of the world), just before the present Era of Mind, or Age of Man.

The researches of scientists during the present half of the nineteenth century have shown that during Miocene times (*i. e.*, the middle, and very hot age of mammalian predominance just preceding the correspondingly cold, Pliocene age), various large animals and trees, similar to those now found in warm countries, inhabited abundantly Greenland and other Arctic regions, even as far north as 75 degrees. At that time there could not have been any perpetual polar ice, unless on high mountains in polar regions.

During the next age—the Pliocene—the heat of the earth abated, polar ice appeared, and doubtless with it Arctic species, while those requiring a warm climate retreated southward, or they were overtaken and exterminated. As the cold of the Glacial Epoch came on and increased in severity, the polar ice became extended southward as a general sheet or stratum of ice along the continents until it reached 40 degrees north latitude in Europe, and 10 degrees less, or about 50 degrees in America. Its margin can be traced by the remnants of a moraine stretching across the United States, from Long Island through middle New Jersey, middle Pennsylvania, thence less distinctly following the Ohio River, crossing the Mississippi, thence following along the south side of the Missouri into Montana. In the far West the moraine is not easily traced, owing to interruptions by the great cross-mountain ranges.

By the increasing cold Arctic species were driven slowly southward, generation after generation, until they occupied the whole of the United States to the Gulf of Mexico, and the whole of Europe to the Mediter-

ranean Sea. As these species came from a common home in the polar regions, they were similar to each other, except such slight modifications as would result from a long journey occupying a vast era of time.

When the rigor of the Glacial Epoch declined, and the sheet of ice gradually retreated to its present position (which occurred not less than eighty thousand or one hundred thousand years ago), Arctic species, following the snow edge, went also northward on both continents to their present home in the polar regions.

But Arctic *conditions* exist as well on *high* elevations of *low* latitudes as on *low* elevations of *high* latitudes; therefore, two ways of escape were open to the retreating Arctic species. When a mountain was encountered, some of them ascended it, following the snow line into the very peaks, and many of them remain stranded there to this day. Others, finding the mountains too low for their constitution, were overtaken on the several heights by the increasing heat, and there exterminated. Other lines of migration on the general plain met with obstacles of wide seas or sterile deserts, where they crouched upon the borders, hemmed in on all sides by other plants, all struggling for the same place, each becoming the ruthless enemy of the others, and all becoming slowly exterminated by the rising temperature.

In time the temperature of the earth assumed its present state of nearly uniform heat in similar latitudes, and the flora and fauna were found dispersed from equator to pole, and from level plain to mountain top, each form where it could best maintain existence.

Then was ushered in the Age of Man, of Stability and Conflict. Then commenced anew the struggle for existence and supremacy on favored localities. Not emigration, but establishment; not tramping, but grounding. There were millions of contestants for only thousands of places.

Only the individual plants and animals best adapted to the circumstances could survive and perpetuate their kind; and this could be accomplished only by means indescribable, and involved the extinction of species innumerable—withdrawn by millions in the conflict waged through ages of years—and all this in addition to the wholesale destruction of species described as consequent upon the vicissitudes of the great Northern Retreat.

The Northern Retreat before the rising heat of the tropics, in its results was vastly different from the exodus of the plants and animals from the north ages previous.

The conditions were not only exactly reversed, but the effect was immeasurably more disastrous. The hegira from the north being caused by the lowering of the earth's temperature, which took effect as well on the mountain tops as in the Arctic region, the flight was simultaneous from both localities.

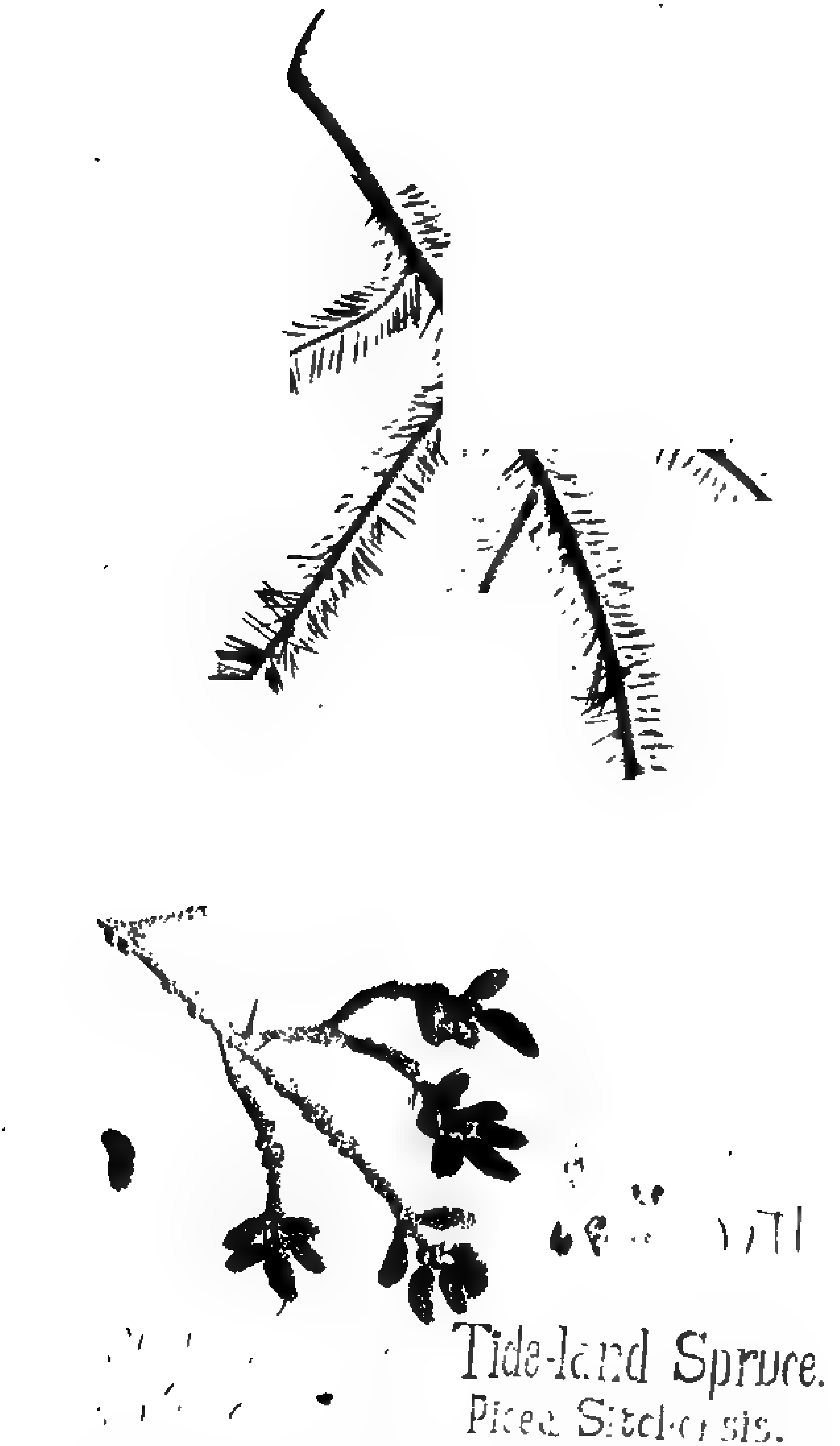
The alpine refugees arrived at the base of the mountains coeval with the arrival of the northerners, and all together, those that could do so made detours around the bases, and so escaped to the plains to pursue their flight.

Those individuals that were squarely overtaken on the northern bulwarks were slaughtered there and then; hence, these northern slopes of the earth's cross-ranges of mountains are the sacrificial altars of the ante-Pliocene plants, but no special dispersion and slaughter by detail marked their southern movement.

On the contrary, the northern retreat was most disastrous. The

Engelmann's Spruce.
Picea Engelmanni.

No. 2.—Bearing branches from trees on the San Francisco Mountains, Northern Arizona. Cones and male flowers, scale, and seeds displayed.



No. 8.—Bearing branches from a tree near Seattle, Washington. Cones and male flowers, scales, seeds, and leaves displayed.

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plants which arrived at the bases of the mountains, range after range, commenced to ascend them, separating from the great mass that passed along the plains. Climbing the acclivities as the snow disappeared, if the summits were reached before the temperature abated, the rising heat caught them there and then; and here on the mountain summits of all climes and regions are the up-lifted sacrificial altars of the most of the Pleistocene plants.

CREATIVE ENERGY AND DEVELOPMENT.

A profound scrutiny of Nature and her phenomena reveals the simple grand truth that every object, every body, in existence, be it a plant, an animal, an orb, or a universe, is the result of an impulse or propulsion of creative energy, the universal spirit of life pervading, controlling, and shaping all forms of matter. These impulses of creative energy are approximately typified by the life-history of a tree struggling against its enemies and environment; those branches best endowed with staying qualities and meeting with least resistance outstrip the others, and eventually occupy the field, leaving behind branches that radiate from the course and are overcome and aborted, the helpful elements of the latter being absorbed by and surrendered up to the dominant currents of life as they swirl upward and onward in the leading stems.

The three main currents or impulses creating the vegetable kingdom have been named SPERMOPHYTA, SPOROPHYTA, and PROTOPHYTA. Of these, the first one is the dominant one, the leading current exhibiting the highest and most elaborated development, and it should be placed in the center of the list where it belongs, and this should be the rule in all classifications.

This leads me to make an announcement: For some time past I have meditated an innovation in scientific classifications. I would place all objects in groups, with the dominant types in their midst, not as now presented in our books, *all in a line at one end of a list!*

The usual way of presenting objects in this lineal order, when they belong unequally on the right and left of a central, advanced point, has long been lamented, but no one that I am aware of has devised a better way.

I submit the following Conception and Schemes of Development:

"UPWARD AND ONWARD."

I conceive Plant Development to be upward and onward along curving lines or impulses of creative energy. These impulses divide and subdivide, as refinement or improvement is gained; when dividing into two branches they are seldom equal, one, the stronger, becomes the farthest advanced; if separating into three or more currents, the central one or ones will have the lead, with the side currents halting behind at unequal distances.

This conception of development suggests the accompanying map schemes of classification. (See Part IV.)

FUNDAMENTAL DISTINCTIONS—DOMINANCE OF CERTAIN LINES.

Even a brief examination of the forest development of the earth, reveals the fact that some lines are much more represented by individuals, at the present age, than others. Some species have a wide range every way, in latitude, longitude, and altitude, as in the Western Yellow Pine and the Douglas Spruce. Others are more or less limited, some to a coast line, others to a narrow belt along a mountain range only a few miles wide at any point; others, still, may cling only to a few protuberances or be lodged in a few depressions at a given altitude of a mountain range; while, lastly, a lone remnant of a species may be found "corralled," as we Westerners say, on a little space of a few acres, as in the newly discovered Brewer Spruce and the rare Bristle-cone Fir.

Certainly those species which are widest dispersed are the stronger; are best qualified to resist encroachments and hold their ground; those of limited range are weaker, their existence depending upon a nice adjustment of the environment, as they are, perhaps, expiring.

DEGREE OF COMPLETENESS.

In the treatment of forest trees in the following pages, the degree of their development (that is, the perfection, more or less, of their reproductive organs primarily) will be the leading thought upon which they will be presented (as they perforce must be presented), in lineal order, though, of course, reference to the "schemes" show that no *lineal order is observed in Nature*, but rather nearly coeval groups in nearly parallel lines.

So the *Pines*, with their fascicled leaves and scaled cones, each a plainly modified and condensed branchlet, is presented first; following are the *Cedars*, with less differentiated fruit organs; then *Larix*, dropping its leaves early; then *Spruce* of many kinds, all with small depending cones; next the *Firs*, with erect cones and deciduous scales, closing the pitch tree tribe of Cone-bearers.

The *Cypresses* and their allies begin with the spiral-coned *Sequoia*; continue with the true Cypresses having cone scales opposite—*opposition* always being an indication of lower development than spiral *alternation*—and closes with the close-fruited *Junipers*, their cones reduced to a berry-like cone, almost devoid of the vestiges of scales. Lastly, the *Yews* close the list of Cone-bearers, their fruit reduced in the true Yew to a shallow, acorn-like cup and its solitary seed, while the Torreya, or False Nutmeg, has a plum-like fruit composed of a single large seed in a closed husk.

ANALOGIES OF THE CONE-BEARERS.

As regards the Cone-bearers of North America and their distribution, we may profit by a consideration of several facts. The species of the eastern slope, fostered by the Atlantic Ocean and the Great Lakes, are, many of them, closely related to certain species of the western slope, fostered by the Pacific Ocean.

Some shrewd observers are convinced that the Atlantic species are what they call the "typical" ones, and the others are merely their western "representatives." Others as reasonably insist that the Pacific species are the typical ones. We have shown that neither one nor the

other is correct; that while families may be divided and their members separated widely, being represented in different, even distant countries, no *species* is "represented" elsewhere. Each is a remnant of a given mass of individuals journeying along the earth, and becoming separated, has been forced into a swamp, driven out onto the plains, or stranded upon a mountain side, just where we find them to-day, by the combined effect of a double migration and its disastrous vicissitudes.

The external, visible facts are that certain species in both regions are so much alike as to indicate recent separation, or the separated portions become subject to similar conditions that cause them to *appear* almost identical.

Scarce an Atlantic species of Conifer is found without a similar species (its analogue) on the Pacific Slope; while others in each region are alone, the greater number of these being in the Northwest.

So the comparison of both species—when there is a pair—will be instructive, and this will be the method pursued in these papers, the Atlantic one, of course, being but briefly described.

ANALOGOUS SPECIES.

Pacific.	*Atlantic.*
Pinus monticola	Pinus strobus.
Pinus ponderosa	Pinus rigida.
Pinus Murrayana	Pinus serotina.
Pinus contorta	Pinus Banksiana.
Pinus Sabiniana	Pinus pungens.
Larix occidentalis	Larix larcina.
Picea Sitchensis	Picea mariana.
Tsuga Mertensiana	Tsuga Canadensis.
Abies grandis	Abies balsamea.
Thuya gigantea	Thuya occidentalis.
Chamæcyparis Lawsoniana	Chamæcyparis sphæroidea.
Juniperus occidentalis	Juniperus Virginiana.
Taxus brevifolia	Taxus Canadensis.

VEGETATIVE AND CARPOLOGICAL CHARACTERS.

The life-history of a plant, for instance of a tree, is a record of two kinds of growth: the first, a building up of framework or scaffolding by means of annual extensions of fibro-vascular or wood bundles and expansions of leaf tissue, until maturity is reached, when suddenly a reverse process is instituted, a condensation of organs and concentration of energies ensues for the production of flower and seed. This process involves two stages of procedure: first, the production of pollen cells and ovule cells, these later, uniting two by two and becoming single seeds, each a plantlet arrested in its development, waiting the time of its entrance upon the stage of activity—the time of sprouting.

The first up-building process is purely vegetable growth, and the characters exhibited thereby are called the vegetative characters, much used for primary distinctions in classification; the second process evolves the pericarp and seed, unitedly called *the fruit*, and its characters may be called the carpological characters (from the Greek *Karpos*, fruit), and these characters are determinative of many distinctions in all the classes, orders, and genera.

These two classes of characters will be much alluded to in the general descriptions. In some groups of plants the vegetative characters will differ most from other groups; in others the carpological are most diverse.

CLASSIFICATION BY FRUIT CHARACTERS.

There being, as shown, a concentration of all energies and strategies for the one purpose—the endowment of seeds with properties or furnishings whereby they may preserve and tide over their contained life-germs—there results an endless variety of appearances, of qualities, etc., in the seeds of plants, implying and proclaiming that after ages of trial and contest, of adaptation and confirmation, a certain *kind* of seed best preserves the integrity of a certain *type* of being.

Over three hundred years ago (1583) the Italian Cæsalpinus enunciated the principle that in the characters of the seed and fruit of plants are to be found the best indices of affinity, the basic principles of classification, though this view was not adopted by following botanists generally until newly presented by Tournefort, nearly two hundred years later, in 1700, and by Jussieu, in 1789.

It follows, then, that characters of the seeds, the spore, the micro-germs of life, being generally uniform throughout the race, are of first importance, and it is corroborative to note that in the latest publications these very terms—seed, spore, and micro-germ—give origin to the names of the three grand divisions of the vegetable kingdom:

1. *Spermophyta*—the seed-bearing plants.
2. *Sporophyta*—the spore-bearing plants.
3. *Protophyta*—first, or germ-bearing plants.

The division of the principal sub-kingdom—the *Spermophyta*—into *Angiospermæ* and *Gymnospermæ*; and the subdivision of the class *Angiospermæ* into *Dicotyledonæ* and *Monocotyledonæ*, proceed also upon the consideration of carpological characters.

FOREIGN TYPES CONSIDERED FIRST.

When a family has representatives distributed well over the earth, the farther ones, for convenience, will be considered first. This order of procedure, connected with that of first considering the strongest species, virtually leads to a description of the common, best known species first; for instance in the treatment of the large families of Spruce and Fir, the Eurasian species are first considered; next, those of Eastern America; lastly, those of the Northwest, beginning with the widest dispersed, and concluding with the extremely local, and perhaps expiring species—the Weeping Spruce, the Bristle-cone Fir, etc.

CLASSIFICATIONS.

General View. (See Scheme I.)

The development of the vegetable kingdom is first presented to the eye in a general scheme designed to show the direction of progress—upward and onward—the relative importance of the various branches, the item of development upon which they divide, and lastly which strains of vigor achieve the highest or best results.

The plant world divides first into three sub-kingdoms, upon the pos-

Picea Breweriana. Photo.

No. 4.—Two trees of this newly discovered Spruce on the Siskiyou Mountains, in Del Norte County, California. Altitude, 6,000 feet.

session or non-possession of sex, and the kind of propagating organs, distinguished as: (1) GERMS, microscopic, sexless, first-forms of plants; (2) SPORES, simple cells of protoplasm, capable of producing plants sexually; (3) SEEDS, usually conspicuous plantlets arrested in their development and mostly encased in two envelopes, often with special endowments to aid in dissemination—as wings, hooks, gums, odors, edible qualities, and the like.

It will be seen that the conspicuous flower and seed-bearing plants lead the grand march with the spore-bearing sub-kingdom next below, while the micro-germs are perhaps lowest and far in the rear—though they may be the fixed condition of higher forms of life continuing to the present epoch.

Neglecting the lower branches we find that the SPERMOPHYTA, or seed-bearing plants, divide into two classes upon the possession or non-possession of an ovary, or seed-vessel—the *Angiospermæ* being analogous in this respect to the Mammals in the animal world and the *Gymnospermæ* to the Reptiles.

The *Angiospermæ* separate into two divisions upon the possession of one or two cotyledons, or seed-lobes, etc.

It will be seen by reference to the terminals of each line or impulse of development that the great order of *Leguminosæ*, or pod-bearing plants, leads all others as the crowning effort of vegetable energy, with the allied *Compositæ* not far in the rear on the one hand, and the *Cupuliferæ* (oaks, etc.), on the other, much farther behind.

The Palms are seen leading the *Monocotyledonæ*, flanked by the Lilies, and Grasses, while the Pines lead off in their great class of naked-seeded plants, just as the *Lycopods*, or club-moss tribe—which, though diminutive plants at present, embraced tree-like growths in past ages—lead in their great sub-kingdom of spore-bearers. Below and behind all are the mysterious PROTOPHYTA, perhaps statical and continued stages of the forms of primeval vegetable impulse.

The pod-bearers, *Leguminosæ*, are the crowning product of vegetable impulse for many reasons, principal of which are, that in this noble order is carried out to the farthest extent the special development of perfect exalbuminous seeds and special one-celled seed cases. The fruit is a single, terminal, free legume, or pod; the flower is the perfection of amplitude in most particulars, and includes the unique papilonaceous, or butterfly corolla; the leaves are spirally arranged, and accompanied by stipules, or lateral appendages, and they are usually compounded, often to the last degree of differentiation, being subdivided and attenuated often to mere filaments or fleshless nerves; also in many species of pod-plants the leaves are visibly sensitive to the touch, or to light and shade. These considerations, added to the general distribution and persistence of the pod-bearers, royally distinguish the order as the leading, as it is one of the largest families extant.

Similarly, but subordinately, in the great side division of GAMOPETALÆ stand the immense order of *Compositæ*, with its carpological characters highly developed indeed, each seed being especially invested with a pericarp, or overcoat, and surmounted by its own floret, yet suffering the degradation of having its originally elongated spike of axillary flowers condensed to a head, or even to a flat disk; also to having one of its floral envelopes—the calyx—reduced to mere pappus, or, as often happens, to be wanting altogether.

The corresponding side division, the APETALÆ, are led by the important trees and shrubs of the anemophilous, or wind-fertilized orders, including the *Cupuliferæ*, or cup-bearing trees, chief of which is the Oak family, this being the most conspicuous arboreous vegetation of the *Angiospermæ*, or seed-vessel-bearing plants.

Class 2. GYMNOSPERMÆ. (See Scheme II.)

NAKED-SEEDED PLANTS.

These are trees and shrubs with wood composed mainly of disk-bearing tissue without proper vessels, flowers always diclinous (*i. e.*, never perfect), but the two sexes separated upon different plants (diœcious), or upon different branchlets of the same plant (monœcious), the ovules straight, either erect or inverted and borne upon flat scales, or in a more or less open perianth. They are fertilized by the direct action of the pollen upon the nucleus, the GYMNOSPERMÆ being thus the analogue of the REPTILIA in the animal kingdom. They are widely distributed, chiefly in the northern hemisphere, and divide into three orders:

2. *Gnetaceæ*—Joint stems.
1. *Coniferæ*—Cone-bearers.
3. *Cycadaceæ*—Palm-like plants.

The highest developed, the leading order of the GYMNOSPERMÆ, as shown, is the paramountly important one of the *Coniferæ*, or Cone-bearers, and properly that order should be analyzed, and its ramifications briefly presented in this place, but as the Cone-bearers comprise the most of the trees of our California forests, we shall have to elaborate the order in detail later on; so for the sake of avoiding repetition we will omit them now, and proceed briefly with the two other flanking and closely related orders.

Order 2. GNETACEÆ.

JOINT-STEM AND ALLIES.

These joint-stemmed plants are found in the hot interiors of both continents. They are comprised in two small tribes, one with but two genera, the other with but a monotypic genus of a most peculiar character.

Tribe 1. GNETINEÆ.

EPHEDRA AND ITS ALLIES.

The genus *Ephedra* is the only one represented on this slope, and is of peculiar interest on account of the medicinal value of all its species.

They are rush-like shrubs, of only three to six feet in height, with yellowish, staminate flowers, in great profusion on a part of the bushes, and little elongated greenish cones upon the others.

The two species of this coast are *Ephedra Californca* and *E. Nevadensis*. The first species is abundant on the plains of San Diego, the other, as its name implies, is found in Nevada, reaching to the foothills of the Sierra Nevada Mountains, and following the arms of the Great Basin, wherever they extend into the California mountains.

Tribe 2. WELWITCHIEÆ.

Welwitchia, the only genus of the second tribe, is represented by a single species, so far discovered—*W. mirabilis*, a truly wonderful plant of South Africa. The stem is short, scarcely rising above the ground, though quite thick, with a broad furrow across the top; the roots are tuberous and very large; the leaves are two only (apparently the original cotyledons), and of immense size, six to seven feet long, by half as wide, thick, strong, leathery, and are spread out flat upon the ground, or divided into strips by the driving winds, in age.

NOTE.—This most curious plant, so unlike a Sierra "Big Tree," with which, however, it is distantly related, is a recent discovery, and though transplanted to the botanical gardens of Europe, is not yet fully understood. Other species may be expected to be revealed by the Stanley discoveries in the arid interior of the dark continent.

Order 3. CYCADACEÆ.

PALM-LIKE PLANTS.

The other side branch of naked-seeded plants form the order *Cycadaceæ.*

These peculiar plants resemble Palms in their thick, short stems, and their large, spreading, spirally disposed leaves. All of them have two kinds of leaves, in alternate sets, one of dry, brown, leathery scales, the other conspicuous, stalked, pinnate leaves, most of these being circinate in vernation, like the fronds of ferns, *i. e.*, unfolding from base to tip, like a crosier.

The male and female flowers are borne on separate plants, and a peculiarity of the male flower is seen in the stamens, which are the largest known, being often one to one and one half feet long. Also, they do not die and fall away soon, but persist for years, and become hardened to woody rods or clubs.

None of these plants are native north of Mexico. Several, notably *Cycas revoluta*, are highly prized plants of greenhouse cultivation.

Order 1. CONIFERÆ. (See Scheme III.)

THE CONE-BEARERS.

The Cone-bearers are resinous, mostly evergreen trees and shrubs, widely distributed, mostly in cool regions of the northern hemisphere. The leaves are either needle-shaped or scale-like; the flowers are *diclinous* (*i. e.*, of two sorts, male, or pollen-bearing, and female, or fruit-bearing); these separated and borne upon the same trees (*monœcious*), or upon different trees (*diœcious*). The male flowers are reduced to stamens only, usually spike-like; the female flowers (aments), a much modified branchlet of leaves having the form of scales or bracts, or they are more or less consolidated, becoming a dry cone or bur, or drupe-like; the seeds in a bony, crustaceous, or papery shell, and naked or winged; embryo straight in an oily albumen; cotyledons often several in a whorl.

The Cone-bearers comprise three sub-orders:

2. *Cupressaceæ*—Cypresses and their allies.
1. *Pinaceæ*—Pines and their allies.
3. *Taxaceæ*—Yews and their allies.

The first and second tribes of CONIFERÆ—*Pinaceæ* and *Cupressaceæ*—must be fully elaborated farther on, so they may be omitted for the present, but the order of their treatment should be mentioned as stated.

Sub-Order 3. TAXACEÆ.

YEWS AND THEIR ALLIES.

The *Taxaceæ* are evergreen, slightly resinous trees and shrubs, with scattered leaves; flowers diœcious, axillary, and solitary, with a single envelope, and naked or surrounded by opposed, over-lapping scales; male flowers, a column of stamens, each filament surmounted by several adnate, pendent, anther-cells; pollen, globose; female flower of a solitary straight ovule, which in fruit becomes a bony-coated seed, surrounded by a fleshy disk or cup or other coating. Embryo in fleshy or flour-like albumen, cotyledons only two, nearly terete.

They are widely distributed, mostly in foreign countries, and are embraced in four sub-tribes of thirteen species. Only one tribe of two genera is represented in America. *Torreya*, the noted genus commemorating Dr. John Torrey, comprises only three species—one in Japan, one in Florida, and the third sparsely found on both the Coast and Sierra Mountains of California, notably in the Yosemite Valley.

The other genus, *Taxus*, the true Yew, has a species in the Eastern States, and a second species—*Taxus brevifolia*—sparsely distributed from southern Alaska along the mountain streams to Southern California.

Sub-Order 1. PINACEÆ. (See Scheme IV.)

PINES AND THEIR ALLIES.

We will now take up the neglected sub-orders of *Coniferæ*, to wit: the *Pinaceæ* and *Cupressaceæ*, to elaborate them briefly, giving the tribes, sub-tribes, and genera.

This sub-order comprises the greater part of the resinous trees of temperate climates. Fruit conical or globose, of woody or leathery scales spirally arranged and imbricated or over-lapping upon an elongated axis. Ovules, one to seven under each scale, inverted, becoming mostly winged seeds. Comprises three tribes:

2. *Araucarieæ*—Austral Pitch Trees.
1. *Abietineæ*—True Pitch Trees.
3. *Cunninghamiæ*—Oriental Pitch Trees.

Tribe I. ABIETINEÆ. (See Scheme V.)

TRUE PITCH TREES.

The very resinous or distinctively pitch-bearing trees are always found in northern or elevated regions, as elsewhere stated, and the head-quarters of best development on the western continent is the peculiarly favored northwest coast of the United States and British America.

No. 5.—Sterile lower branchlet eight feet long and one quarter inch thick at base
Photograph secured before the leaves had fallen.

Here, scattered along the many ranges of mountains, and often filling the plains and valleys, creeping close to the line of perpetual snow, either on the alpine peaks or along the edge of the frozen tundras of the Arctic regions, the numerous species are found, different species requiring, or mayhap, submitting to different degrees of temperature or conditions of environment.

They divide into two sub-tribes upon vegetative characters, to wit: the possession or non-possession of secondary, conspicuous leaves in fascicles.

Sub-Tribe 1. FASCICULARES.

Trees of this sub-tribe have their secondary leaves conspicuous, and in fascicles or bundles. They include three undoubted genera:

2. *Cedrus*—True Cedar, with fruit erect.
1. *Pinus*—True Pine; fruit diverse.
3. *Larix*—Larch and False Larch; leaves deciduous.

Sub-Tribe 2. SOLITARES.

This sub-tribe have all the leaves small, solitary, and scattered. They comprise two groups formerly considered as types of two genera; lately, the first of them divided into three genera.

These last, for purposes of classification, may receive the name *Penderes* (Lat. *pendeo*, to hang), alluding to the pendent cones.

1. *Penderes*—Cones dependent, scales persistent. Spruce.
2. *Abies*—Cones erect, scales deciduous. True Fir.

RELATION OF THE ABIETINEÆ OR PITCH TREES TO EACH OTHER.

The degree of development to which the several genera have attained is indicated by Scheme V, the Pines with their sheathed leaves and greatly diversified fruit, leading all; the Hemlock Spruces with their fine, fern-like sprays of foliage, last and in the rear.

They all agree in having similar fruit, a woody or leathery cone or bur of imbricated or over-lapping scales arranged on an elongated axis, each scale bearing two inverted ovules becoming the seeds, which are usually long-winged.

They agree also in the vegetative characters of conspicuous acicular or needle-shaped, mostly persistent leaves—the principal exception being the Larch with deciduous leaves—but this has similar male flowers.

GENERA AND GROUPS OF THE ABIETINEÆ.

The advanced and most conspicuous of them all—the Pines—are very numerous, widely distributed over northern temperate regions, often divided into two sub-genera:

1. *Pinaster*—Cones armed with spines or prickles.
2. *Strobus*—Cones smooth, devoid of spines.

The nearest tree to the Pines in certain characters is *Cedrus*, the historical Cedar, dividing into two forms:

1. *Deciduæ*—Cone scales deciduous.
2. *Permanens*—Cone scales persistent.

The Larches differ from the other trees of the great tribe of ABIETINEÆ in having deciduous leaves. There are two genera:

1. *Pseudo-larix*—Cones pendent. False Larch.
2. *Larix*—Cones erect. True Larch.

The most advanced group of the solitary-leaved genera, which is conveniently named PENDERES, divides into four genera:

3. *Tsuga*—Seeds resin-bearing.
   1. *Picea*—Leaves quadrangular.
   2. *Hesperopeuce*—Cone scales becoming reflexed.
4. *Pseudo-tsuga*—Cone bracts exserted.

The remaining genus of the tribe of Pitch Trees is the noble genus of True Fir (*Abies*), dividing upon important characters into two groups:

Group 1. MEGACARPÆ—Cones large, bark red within.

Group 2. MICROCARPÆ—Cones smaller, bark white within.

Tribe II. ARAUCARIEÆ. (See Scheme IV.)

AUSTRAL PITCH TREES.

These trees of Australasia and the southern part of South America are usually large and very symmetrical plants of low development, but often of great size and usefulness. Plants diœcious.

They divide into two sections:

Section 1. *Dammaræ*—Wax Pines.

Section 2. *Araucariæ*—Araucarias.

The Wax Pines comprise two sorts, one with leaves alternate and scattered, the other with leaves opposite, all of the East Indies, and extensively cultivated.

The Araucarias comprise two distinct sections:

Section 1. *Eutacta*, or False Araucarias.—All large trees of Australia with small terminal, globular cones, and subulate or awl-shaped leaves.

This section includes our commonly cultivated and exquisitely beautiful Norfolk Island Pines, matchless in the symmetry of their branches, in regular whorls, and in their broad sprays of foliage and the profusion of their long, finger-like twigs, bristling with the green, awl-shaped leaves.

Section 2. *Columbea*, or True Araucarias.—All very large trees in their native homes, with very large, oblate, close-scaled cones. Leaves scale-like, or stalked.

The name Araucaria is derived from that of a tribe of natives inhabiting the mountains of Chili, where the *Araucaria imbricata* (common in cultivation and known as "Monkey Puzzle") grows abundantly, bearing cones six to eight inches long, producing two to three hundred seeds, each an inch or an inch and a half long, very nutritious and affording the inhabitants a never failing supply of food.

Tribe III. CUNNINGHAMIEÆ. (See Scheme IV.)

ORIENTAL PITCH TREES.

This tribe comprises three genera of the East Indies, Japan, and the near continental region of China. Principal of these trees in cultiva-

tion are the "Parasol Pine," with its long and large leaves in whorls or tufts on the ends of the branches, and the so called "Joint-stem Yew," with its curious stems ringed as if jointed, and the little, often artificially dwarfed, pot-plants from China and Japan—the *Cunninghamia*.

Sub-Order 2. CUPRESSACEÆ. (See Scheme VI.)

CYPRESSES AND THEIR ALLIES.

These important trees are widely distributed, and include some of the largest trees known, and they were particularly abundant in former ages of the earth. The leaf and fruit characters (opposed scales, etc.) are not so far advanced as in the central branch of the Cone-bearers, being more or less consolidated. Leaves opposite or ternate, usually scale-like.

They divide into three tribes:

2. *Cupressineæ*—Cone-scales verticillate, or opposite.
1. *Taxodineæ*—Scales spiral and peltate.
3. *Juniperineæ*—Fruit berry-like, with vestiges of scales.

Tribe 1. TAXODINEÆ.

Taxodineæ, the leading tribe, have cones with the scales spirally arranged, and ob-pyramidal, terminating in rounded bosses, or flat, shield-like heads.

They divide into two groups:

Group 1. TAXODIEÆ—Cone-axis elongated, comprising two genera; one on the Pacific Slope, the other in the Eastern States.

Group 2. GLYPTOSTROBI—Cone-axis depressed, comprising two genera; neither of them found on the Pacific Slope.

The TAXODIEÆ include the two genera:

1. *Sequoia*—Redwood, Big Tree.
2. *Taxodium*—Eastern Bald Cypress.

Tribe 2. CUPRESSINEÆ.

This tribe comprises a large number of groups and genera, most of which are not found in North America.

Four important genera are indigenous to this country, and all found in the great Northwest forests. We will only deal with these. They are embraced in two groups:

Group 1. ARBOR-VITÆ—Fruit elongated, with the scales valvate. Includes two important genera:

1. *Thuya*—American Cedar, or Arbor-vitæ.
2. *Libocedrus*—Incense, or Post Cedar.

Group 2. CUPRESSI—Fruit globose, with ob-pyramidal, peltate scales. Includes two large genera:

1. *Chamæcyparis*—Ground Cypress.
2. *Cupressus*—True Cypress.

Tribe 3. JUNIPERINEÆ.

This, the last tribe of cypress-like trees, the Juniper, is peculiar in having consolidated fruit and a wide range of habitat, from sea level to alpine heights. They are divided by some authors into two, and by others into three sub-genera, upon slight differences of the fruit, and upon the arrangement of their small, scale-like leaves.

1. *Juniperus vera*—True Juniper.
2. *Sabina*—Savin Juniper.

Of the true Junipers, with leaves ternate and pungent, there are two species in California.

Of the Savin Junipers, with leaves opposite and scale-like, there are two, or perhaps three, in California.

CLASSIFIED LIST OF CONE-BEARERS.

Described by J. G. Lemmon in this (Third) Biennial Report of the California State Board of Forestry.

Tribe 1. ABIETINEÆ. Pitch Trees.

(Twenty-nine species. Eleven in California.)

Pinus—True Pine.

(Eighteen species in California; described in previous report.)

Cedrus—True Cedar.

C. Deodara, Loudon .... "Tree of God," Indian Cedar.
C. Libani, Barrelier .... Cedar of Lebanon.

Larix—Larch, or Tamarack.

L. Europeæ, De Candolle .... European Larch.
L. larcina, Koch .... American Larch.
L. occidentalis, Nuttall .... Western Larch.
L. Lyallii, Parlatore .... Lyall's, or Woolly Larch.

Picea—True Spruce.

P. excelsa, Link .... Norway Spruce.
P. laxa, Sargent .... White Spruce.
P. Mariana, Miller .... Black Spruce.
P. Engelmanni, Engelmann .... Engelmann's Spruce.
P. pungens, Engelmann .... Prickly, or Blue Spruce.
P. Sitchensis, Carrière .... Tide-land Spruce.
P. Breweriana, S. Watson .... Brewer's, or Weeping Spruce.

Tsuga—Hemlock Spruce.

T. Canadensis, Carrière .... Canadian Hemlock.
T. Caroliniana, Engelmann .... Carolinian Hemlock.
T. Mertensiana, Carrière .... Western Hemlock.

Hesperopeuce—Western Spruce.

H. Pattoniana, Lemmon .... Alpine Western Spruce.

Pseudotsuga—False Spruce.

P. taxifolia, Britton .... Douglas Spruce.
P. macrocarpa, Lemmon .... Big-cone Spruce.

Abies—True Fir, or Silver Fir.

A. taxifolia, Desfontaine .... European Silver Fir.
A. balsamifera, Michaux .... Atlantic Silver Fir.
A. religiosa, Lindley .... Mexican Sacred Fir.

A. amabilis, Forbes.............Lovely, or Oregon Red Fir.
A. nobilis, Lindley.............Noble, or Bracted Red Fir.
A. magnifica, Murray.............Magnificent, or California Red Fir.
A. grandis, Lindley.............Grand, or Oregon White Fir.
A. Lowiana, Murray.............Low's, or California White Fir.
A. Concolor, Lindley.............Colorado White Fir.
A. venusta, Sargent.............Bristle-cone Fir.
A. lasiocarpa, Nuttall.............Downy, or Sub-Alpine Fir.

Tribe 2. CUPRESSACEÆ. Cypresses and their allies.

(Sixteen species. Eleven in California.)

Sub-Tribe A. TAXODINEÆ.

Sequoia—Redwood.

S. sempervirens, Endlicher.............Coast Redwood.
S. gigantea, Decaisne.............Big Tree, or Giant Sequoia.

Sub-Tribe B. CUPRESSEÆ.

Thuya—American Cedar.

T. occidentalis, Linnæus.............Atlantic White Cedar.
T. gigantea, Nuttall.............Gigantic Red Cedar.

Libocedrus—Incense Cedar.

L. decurrens, Torrey.............California Post Cedar.

Chamæcyparis—Ground Cypress.

C. sphæroidea, Spach.............Swamp Cypress.
C. Nutkaensis, Spach.............Sitka Cypress.
C. Lawsoniana, Parlatore.............Lawson's Cypress.

Cupressus—True Cypress.

C. Arizonica, Greene.............Arizona Red Bark Cypress.
C. macrocarpa, Hartweg.............Monterey Cypress.
C. Goveniana, Gordon.............North Coast Cypress.
C. Macnabiana, Murray.............Shasta Cypress.

Sub-Tribe C. JUNIPERINÆ.

Juniperus—Juniper.

J. pachyphlœa, Torrey.............Thick-bark Juniper.
J. Utahensis, Lemmon.............Great Basin Juniper.
J. occidentalis, Hooker.............Western Juniper.
J. Californica, Carrière.............California Juniper.
J. communis, Linn, var. *alpina*, Engel.............Creeping or Alpine Juniper.

Sub-Order. TAXACEÆ. Yews and their allies.

(Six species. Two in California.)

Torreya—False Nutmeg.

T. taxifolia, Arnott.............Florida Nutmeg.
T. Californica, Torrey.............California Nutmeg.

Taxus—True Yew.

T. baccata, Linnæus.............Common European Yew.
T. Canadensis, Willdenow.............Canadian Yew.
T. Floridana, Nuttall.............Florida Yew.
T. brevifolia, Nuttall.............Western Yew.

DISTRIBUTION OF CONE-BEARERS.

The table includes only those genera represented by species in North America north of Mexico.

Genera.	No. of Species in—			
	Whole World.	North America.	Pacific Slope.	California.
ABIETINEÆ. *True Pitch Trees.*				
1. Pinus—True Pine	77	35	24	18
2. Larix—Larch, or Tamarack	8	3	2	-------
3. Picea—True, or Typical Spruce	11	6	5	2
4. Tsuga—Hemlock Spruce	7	4	2	2
5. Pseudotsuga—False Spruce	2	2	2	2
6. Hesperopeuce—Western Spruce	1	1	1	1
7. Abies—True Fir	25	12	9	7
CUPRESSACEÆ. *Cypresses and their Allies.*				
1. Sequoia—Redwood, Big Tree	2	2	2	2
2. Thuya—Red Cedar	6	2	1	1
3. Libocedrus—Incense Cedar	4	1	1	1
4. Chamæcyparis—Ground Cypress	2	2	2	1
5. Cupressus—True Cypress	14	8	4	3
6. Juniperus—Juniper	25	8	6	4
TAXACEÆ. *Yews and their Allies.*				
1. Torreya—False Nutmeg	4	2	1	1
2. Taxus—True Yew	7	3	1	1
Total number of species	195	91	63	46

No. 6.—Bearing upper branch, showing the cones attenuated at base, the unequal scales, and the short, divergent leaves.

PART II.—DESCRIPTION OF GENERA AND SPECIES.

PINUS, Tournefort.

TRUE PINE.

The True Pines are found in northern and elevated regions of North America, Europe, and Asia, with one species in northern Africa.

They are usually readily distinguished as resin-producing, cone-bearing, evergreen trees; the principal foliage consisting of secondary, conspicuous leaves, which are needle-shaped, usually rigid, produced in fascicles or bundles of two to five (one species with solitary leaves) from the axils of linear, scale-like, primary leaves, and surrounded at base by a sheath of membranous scales—these secondary, conspicuous leaves, being compressed into fascicles, are either semi-terete, or triangular, according to the number of leaves in a fascicle.

True Pines are *monœcious* (*i. e.*, the flowers are on the same tree but separated), the male or pollen-bearing flowers on one branchlet and the female or fruit-bearing flowers on another. The fruit becoming a bur or cone, is either sub-terminal (*i. e.*, produced near the terminal leaf-bud) or lateral (*i. e.*, among the leaves along the growing shoot of the season). The cone is composed of numerous spirally over-lapping, woody scales, each bearing upon the free exposed surface a terminal or dorsal protuberance, which is either unarmed or else is furnished with a prickle, spine, or strong hook.

The cone-bracts, arrested in their development, and concealed at maturity by the scales, become thickened and corky, and they assist in forming cavities for the two inverted ovules becoming the seeds. The seeds are invested by a leathery or bony testa or shell, which is usually surrounded by the rim-like base of the wing. Cotyledons normally five to fifteen, in a whorl or verticil.

The male flowers are oblong or cylindrical columns of peculiar stamens, with double anthers opening longitudinally. Pollen abundant, bilobed, carried on the wind by two air sacs.

The fruit of the Pine requires two years to complete its growth (one European and one American species require three years).

The word "pine" is by some writers asserted to be derived from the Greek "*pion*," meaning fat, from the abundance of pitch or resin with which the family abounds; others declare that the word is derived from the word "pin," in allusion to its needle-like leaves, while still others trace its origin from the Celtic "pen," a rock or mountain, in allusion to the localities where the Pine is principally found.

The Pines compose the largest genus of the *Coniferæ*, or Cone-bearers, and comprise seventy-seven species; most of them are very valuable, of surpassing use to man.

The discussion of the species of the Pine family, especially of those inhabiting the Pacific Slope, was taken up in the Second Biennial Report of the California State Board of Forestry, to which the reader is referred.

CEDRUS, Tournefort.

TRUE CEDAR—NOTED TREES OF HISTORY AND SENTIMENT.

The True Cedars constitute a small but celebrated genus of trees comprised in three species. One of them is found sparsely growing upon Mount Lebanon, of Palestine; another is abundant upon the Himalaya Mountains, and the third species upon the Atlas Mountains of northern Africa.

The Cedars are so often seen in cultivation, and are so renowned in history, poetry, and prophecy, that their discussion is always full of interest.

1. CEDRUS LIBANI, Barrelier.

CEDAR OF LEBANON.

Palestine being the home of modern religious thought, and the Cedar of Lebanon being the most conspicuous tree of all the region, its characters of long, spreading limbs waving and beckoning in the winds upon the lofty heights of the sacred mountain, naturally afforded many a simile and image to poet and patriarch.

Lamartine, who visited the Cedars of Lebanon in 1838, wrote of them: "These trees are the most celebrated natural wonders in the world."

The ancients thought they grew nowhere else than upon Mount Lebanon, above all other vegetation—thus being peculiarly set apart—a belief which powerfully affected their religious ideas and at once excited veneration.

The Arabs, of all sects, to this day attribute to these trees not only vegetative force which enables them to live forever, but also a soul having the power to express consciousness and feeling similar to animals, and approaching the intelligence of man; in fact, in the Arab mind they are divine beings in the form of trees.

Solomon desired to use some of this Cedar in the construction of interior parts of his temples, so Hiram, King of Tyre, history states, destroyed his forest to oblige him.

The original forests on the Lebanon Mountains, the only trees known to the ancients, were once quite extensive, but this sacred grove was always small and the number is steadily decreasing. In 1550 there were thirty, in 1600 but twenty-four were left. In 1650 the number was reduced to twenty-two, and fifty years thereafter (1700) there remained but seven of the majestic, long-armed relics of past centuries.

The largest of these was thirty feet in diameter. None are remarkable for height, but rather for their large and long limbs. If planted in forests they might become lofty, but here alone on the plateau of Lebanon, they give point to the Hebrew poet's simile: "They shall spread out their branches like the Cedar."

The Maronite Christians inhabiting Lebanon are scarcely less pronounced in their regard for this tree than the Moslem Arabs, for annually the Patriarch of that sect, attended by scores of bishops, priests, monks, and five or six thousand of devotees, ascend to the Cedar grove and there celebrate in their shade the "Feast of the Transfiguration," and ecclesiastical censures are denounced against those who shall injure these consecrated trees in any manner.

These seven old trees are, to-day, the only living witnesses of biblical events. "What prayers have ascended from beneath them," writes the historian, "and where is there on earth a more beautiful temple than this one so near Heaven itself?" "What dias more appropriate than this upper plateau of Lebanon upon which so many generations of different nations, tongues, and creeds have worshiped the same God."

In a delightful article published in the "Pacific Rural Press," by Mrs. Jeannie C. Carr, of Pasadena, Cal., she states:

"The oldest Cedar of Lebanon in Europe is growing in the *Jardin de Plantes*, in Paris, where it was planted by the elder De Candolle, who brought it from Palestine over a century ago. It is related that the vessel in which he crossed the Mediterranean was unseaworthy, and during the prolonged voyage the sailors and passengers suffered greatly from the scarcity of water, but De Candolle resolutely denied himself, and gave his scanty portion to the little tree, which, thus saved from perishing, has become the living monument of the great botanist."

The oldest Cedar of Lebanon in America is in Philadelphia, raised from seed planted by the veteran American botanist, Bartram, in his now famous garden.

Until 1770, when Pallas discovered a grove of trees of this species in the north of Russia, the *Cedrus Libani* was supposed to be confined to the single consecrated grove mentioned. Recently other groves in the vicinity of the first one have been detected.

Dr. George E. Post, of the Syrian College, at Beirut, in 1887 made a careful botanical exploration of Syria and Palestine. From a copy of his report to the Victoria Institute in 1888, kindly sent me by Dr. Maxwell T. Masters, editor of the "Gardener's Chronicle," I am enabled to give the latest information concerning these preëminently historic and interesting trees.

"Lebanon and Anti-Lebanon were once heavily timbered," he writes. The many allusions in Scripture indicate that at least at the time of Joshua, Lebanon was a forest-clothed range. Of its Cedar forests only a few groves remain. They are as follows: The northernmost thus far noted is that of Besherri, the famous "Cedars of the Lord," with about four hundred and fifty trees. A few miles south are the forests of the Maronite Patriarch at "El Hadeth." Farther south are groves at four other stations, and, all told, they comprise a not inconsiderable forest development, not at all liable to soon become extinct.

From another explorer, H. Christ, in "Garden and Forest," for May 1, 1890, we learn that the headquarters of the Cedar of Lebanon are upon the lofty range of Cilicia, to the northward, and that the station on Mount Lebanon is the most southern locality known for the species. Also, that the "Cedar" used by Solomon in building his temple, and subsequently by Ezra in rebuilding it, could not have been the True Cedar at all, but was doubtless a Cypress—the *Cupressus sempervirens*—this tree being still found abundant in the valleys of Palestine. This tree furnishes a resinous, fragrant, hard, and durable timber of a beautiful brown color—all eminently qualifying it for building purposes, while that of the True Cedar of Lebanon is whitish, soft, and not durable—all very poor qualities for the uses ascribed to the Cedar of history.

2. Cedrus Deodara, Loudon.

DEODAR CEDAR ("TREE OF GOD").

This tree is a still more renowned and historical one, if possible, than the Cedar of Lebanon; and, because it is greatly prized and is often met with in our lawns and parks, it should be briefly sketched. The Deodar Cedar grows abundantly at high elevations upon several mountain ranges of Upper India, particularly forming dense forests on the high southern slopes of the great Himalaya Range, where they receive an annual rainfall of one hundred and twenty inches, and assume magnificent proportions.

The mountain-inhabiting Hindoos, during ages for which chronology has no complete record, have been known to venerate and protect these trees with religious care, their name for the tree, "Deva-daru," meaning Tree of God.

The Deodar Cedar becomes a large tree of twenty to thirty feet in circuit, with few long, spreading limbs; the cone is much larger than that of the other species—some four or five inches in length, and half as thick; the leaves are whitish—"silvery," as it is called—instead of dark green, as in the other species.

A third species, but little known, is on the Atlas Mountains of Algeria, in Africa, and is a small tree, with small cones and short, silvery leaves.

From a critical study of the Cedar by Sir Joseph Hooker, he concludes that the three so called species are but varieties of one species, differing mainly in the dimensions rather than essential characters, but so radical a conclusion as that, in face of the fact that these forms are widely separated from each other on distant mountain ranges, would reduce a host of our botanical names to synonyms and introduce great confusion into our nomenclature, besides ignoring one of the principal factors in the production of species, to wit: the separation of forms of a common original type by the disturbances in Pliocene times (as described), and their subsequent divergence under the pressure of environment, compelling more or less of modification in the course of vast ages of development.

The two forms or species of True Cedar—*Cedrus Libani* and *C. Deodara*—are largely cultivated in California, and may be distinguished by the following characters:

The Cedar of Lebanon has very dense, grass-green leaves in alternate tufts or fascicles of about thirty leaves each; they are rigid, partially quadrangular, acute, pointed, about an inch long. Branchlets are disposed in a flat, fan-like manner on the long, weeping limbs.

The Great India Cedar, or "Tree of God," has very glaucous, slender, longer leaves, one to two inches long; those on the principal branchlets collected into fascicles of thirty to sixty each; those upon young shoots, solitary and alternate.

The leaves of both species, when they fall away, leave a stout, persistent leaf-base on the branchlet similar to this character of the Spruce and Hemlock families.

LARIX, Tournefort.

LARCH OR TAMARACK—RARE TREES OF EXCEEDING DURABILITY.

Beautiful and useful as is the Larch tree, it has no prominent place in history, neither poets nor historians having much to say about it. This may be owing to its deciduous foliage, the ancients being enthusiastic in praise of the evergreen inhabitants of their mountain heights.

Also, the importance of the durable Larch wood in naval architecture is a modern discovery, as well as the value of its bark in tanning.

Lastly, the Larch has obtained wide appreciation as an ornamental tree, being particularly acceptable where shade is not desirable in winter; but it has been principally prized in all ages for its imperishable timber.

3. Larix Europæa, De Candolle.

EUROPEAN LARCH.

The native home of the Common Larch of Europe is the two distinct ranges of the Alps and the Apennines, but it is not found on the Pyrenees or the other western ranges. It thrives in higher regions than any other tree, often hanging over rocks and precipices which have never been trodden by human foot.

In favorable situations the trees arrive at maturity and excellence of timber in forty years—much less time than most timber trees. Its durability is most remarkable and without parallel, either when exposed to water, to underground conditions, or in the atmosphere.

It is well known that the log cottages of the peasantry in Switzerland endure for centuries without change. The timber is invaluable for shingles, weather boarding, props, and fence posts. For vine supports the Larch wood is much used, the props and trellises remaining as first constructed for an indefinite period—generations of vines succeeding each other with no visible decay of their support.

In most cases the proprietors of vineyards are ignorant of the epoch when their vine props were first planted; they received them from their fathers, and in the same state they will transmit them to posterity.

Supports made of Pine, Spruce, or Fir for the same purposes would not endure more than ten or twelve years.

The endurance of the Larch wood is due to its resinous character. A cubic foot weighs seventy pounds when green and thirty-six pounds when dry.

The Venice turpentine of commerce is derived from the Larch, and a full grown tree yields annually seven or eight pounds for forty or fifty years in succession.

The bark of the Larch is highly prized for its tannin, and is equal to that of the Birch so much used in northern Europe, particularly Scandinavia and Russia. The fine grain of the Larch wood fits it for being made into panels for painting, and several of the prized relics by the old masters are painted on prepared Larch.

4. Larix Larcina (Koch.), Americana (Michx.).

AMERICAN LARCH OR TAMARACK.

The American Larch, under many local names for its marked varieties, is distributed well over the northern part of the Eastern States and provinces, extending to within the Arctic Circle near the mouth of the Mackenzie River. Unlike its European relative, and also unlike its western congeners (next to be described), the American Larch does not affect rocky, alpine heights, but rather loves the wet swamps of low lands and mountain intervale. Around Hudson's Bay it occupies the broad open plains in its best estate.

One variety, *microcarpa*, the Red Larch, has small red or violet cones only half an inch long. Variety *pendula*, inhabiting the coldest and gloomiest exposures of the Alleghany Mountains, is distinguished by having few, remote, long, slender, pendulous branches with cones three fourths of an inch long, easily detached from the branchlets; the cones of most other Larches are remarkable for their persistence for an indefinite period.

The bark is smooth, and polished on the trunk and large limbs, but rough on the smaller branches and twigs.

The male flowers appear before the leaves, and are small, oblong clusters of yellow flowers.

The wood of the American Larch is superior to any species of the other Pitch Trees, being exceedingly strong and durable. In Canada East it is much esteemed for building timber, and in the maritime regions it is much in demand for ship knees and other articles where strength and durability are desired.

PACIFIC LARCHES.

There are two species of *Larix* inhabiting the great Northwest forests, both in cross-ranges connecting the Rocky Mountains with the Cascade Mountains of the Sound region, but neither of them are certainly known to reach the boundary of California; though one of the species has lately been detected in the Coast Ranges of Oregon within two hundred miles of the boundary of California, and may well be suspected of occupying secluded stations in the Siskiyou and Trinity Mountains.

5. Larix occidentalis, Nuttall. The Great Western Larch or Tamarack.

This splendid, symmetrical tree, attaining one hundred and twenty to one hundred and fifty feet with the form of a perfect pyramid, is quite widely distributed along the mountains of the Northwest, from the western slopes of the Rocky Mountains to the Selkirk and Gold Ranges of British Columbia and the eastern slopes of the Oregon Cascades. It is scattered among other trees at elevations of two thousand five hundred to five thousand feet.

The trunks are tall and straight, the lower branches being nearly horizontal, or slightly declining, the upper more or less ascending; the young shoots blackish, and terminating in numerous globular, blackish buds.

Cones solitary, erect, ovate-globose, three fourths of an inch long, orbicular, loosely imbricated, sub-cartilaginous, convex, and shining on the back, reflexed and entire on the margins; the bracts elliptic, acutely

No. 7.—A small tree near Portland, Oregon, 110 feet in height, with characteristically declined principal limbs. From a photograph by J. G. Lemmon.

pointed, and long exserted beyond the scales, giving the cones a decidedly bristly appearance.

The seeds are white, with short, pale wings.

Citizens of the Eastern States, who visit the Northwest, are surprised to find Tamarack trees occupying dry, exposed ridges on mountain sides, instead of in the low swamps that the eastern species affect, and still more to find the timber of the western species so valuable and popular for all purposes of building, such as the manufacture of bridges, railroad ties, fence posts, and all other uses where durability is desired.

A peculiarity of the tree is the thick, coarse bark that has the protective merit of long resisting the action of forest fires.

Recently surveyors for the California and Oregon Railway discovered a grove of Tamarack trees on the upper waters of Luckiamute River, one of the small western branches of the Willamette River, and near the summit of the low range of coast mountains southwest of Dallas, Oregon.

Little could be learned of the trees except that they were tall, straight, and seemed suitable for purposes of bridge building, railroad ties, and perhaps for general lumber. Examination is desirable to determine whether or not this is a distinct species, but the probabilities are that it is an outlying form of *Larix occidentalis*, the Great Western Larch, described.

6. Larix Lyallii, Parlatore. Lyall's Larch, or the Woolly Larch.

This is a remarkable species of Larch, being a low, much branched, straggling tree on alpine situations of six thousand to seven thousand feet altitude; sparsely found on the northern Cascade Mountains and in the central Rocky Mountains, generally upon northern exposures mingled with other conifers, especially the Bristle-Cone and the White-Bark Pines and the Alpine Western Spruce.

The leaves on young shoots are solitary, scattered, about an inch long; the secondary leaves on the ends of very short branchlets are in fascicles, or bundles of forty to fifty leaves, soft, short, about three fourths of an inch long. Branches nearly horizontal with the young shoots, and the buds densely clothed with whitish, cobwebby wool.

The cones are apple-green or purple, and very large—the largest known of its genus—two to two and one half inches long, and one inch in thickness; oblong, with depressed not attenuated apex; scales numerous, loosely overlapping, cartilaginous, nearly orbicular, convex on the back, the thin margins ciliated or fringed with long white hairs; bracts elliptic, wavy-edged, and with the middle nerve prolonged into an awl-shaped point longer than the scale; seeds, small with large wings.

Unlike other species of Larch, the cones are promptly deciduous, reminding one of characters of the Fir family with which the Larches are often associated in classification.

The alpine habit, the peculiar color and large size and deciduous character of the cones, and the woolly branchlets and bud scales, mark this Larch as the most curious and striking of all the species known.

PENDERES, Lemmon.

THE SPRUCES—PENDENT FRUITED TREES.

Under the term *Penderes* (Lat. *pendeo*, to hang), alluding to the pendent cones, I have placed, for convenience of discussion, the pitch trees that bear solitary, scattered leaves, and pendent, persistent-scaled cones—the special characteristics of the Spruce family.

The group comprises four genera: *Picea*, the True or Typical Spruce; *Tsuga*, the Hemlock Spruce; *Pseudo-tsuga*, the False Hemlock-Spruce; and *Hespero-peuce*, the Alpine Western Spruce—each genus represented in California by one or two species.

They are all graceful trees of pyramidal or spire form, growing slowly and forming tough timber. The flowers of both kinds are borne on or near the ends of last year's branchlets; the males are spike-like columns of stamens on a receptacle surrounded at base by several involucral bud-scales. The leaves are scattered, linear or needle-shaped, and persistent from two to several years.

The Spruces are nearest to the Pines in characters of their fruit, and between them and the Firs. They differ from the Pines in maturing their fruit in one year instead of two; the bracts of the cones remain membranous, instead of becoming corky; the leaves are scattered or solitary, instead of fascicled, and with sheaths at the base, mostly entire instead of serrulate, etc.

They differ from the Firs in having the cones pendulous from any of the branchlets instead of erect upon the upper ones, and in having the scales and bracts persistent instead of deciduous; also, the trees have usually scattered instead of verticillate branches, and the timber is tougher and harder with more resin.

The three generally accepted genera first named (and the other which I have just added), divide upon a few minor, yet distinct characters here shown, to wit:

1. *Picea*, Link. True Spruce.

The branchlets of the True Spruce are rough from the presence of prominent leaf bases that become hardened and persistent; the cones are terminal on leafy branchlets; the bracts are smaller than the scales; the leaves are sessile (*i. e.*, not narrowed into stalks at base), keeled on both upper and lower sides and with two lateral resin ducts from end to end; the seeds are without resin vesicles.

2. *Tsuga*, Carrière. Hemlock Spruce.

The branchlets of the Hemlock Spruce are rough like the True Spruce; the cones are also terminal, very small; the bracts are similar; but the leaves are petioled (*i. e.*, narrowed at base into a foot-stalk), and they each have a single resin-duct on the back; the seeds are provided with resin vesicles on the upper surface—in this respect resembling the Fir.

3. *Pseudotsuga*, Carrière. False Hemlock Spruce.

The branchlets of the False Spruce are smooth; the flat leaf-scars transversely oval, the leaves petioled (*i. e.*, narrowed at base); the bracts

of the cones are three-parted and much longer than the scales (*i. e.*, they are exserted from between the scales of the cone), and the seeds are devoid of resin vesicles.

In a few respects this last genus approaches the Firs: they have similar smooth branchlets and exserted bracts; thus justifying their arrangement next to the great family of Firs.

4. *Hesperopeuce*, Lemmon. Alpine Western Spruce.

This genus, newly separated from *Tsuga*, is characterized by its alpine habitat; its cones are larger than any Hemlock Spruce, two to three inches long; oblong-cylindrical; scales numerous, nearly of the same size; reflexed at maturity; broader than long, four to eight lines wide; striate, with thin, wavy, rounded border; bracts small, spatulate, three to four lines long; seeds angular, with resin vesicles; wings elliptical, three to six lines long; leaves linear, scattered, quadrangular keeled above and below; resin duct solitary and large.

This Spruce greatly differs from the Hemlock Spruces in appearance, fruit, and foliage, and equally differs from the False Spruces.

EUROPEAN SPRUCES.

The large, almost unbroken forests of northern Russia and of Siberia are but little known, but the sometime vast forests of western Europe, especially of the Scandinavian Peninsula and the gulf region of the Bothnia, abounded in Firs and Spruces that in all historic times have engaged attention upon many important considerations—their value for ship timbers and spars, house-building lumber, domestic fuel, terebinthine products, their usefulness for ornamentation; and, lately, for reforesting regions that have been denuded by the ruthless hand of man.

Chief of these European trees are the famous *Picea excelsa*, or Norway Spruce, and the *Abies pectinata*, or Common Silver Fir.

These being characteristic of all, the coniferous trees of Europe may well be briefly described (each in its place), for we shall find, also, that in many respects they resemble our own royal trees.

7. Picea excelsa, Link. Common Norway Spruce.

The Norway Spruce is common to the mountains of all northern Europe, as well as the higher Alps, the Carpathian, and the Pyrenees, reaching the elevation of six thousand to seven thousand feet, where it becomes dwarfed to a low shrub. It is wanting in a natural state on the whole chain of Apennines, as also in the warm latitudes of the Mediterranean countries. It is very commonly planted for various purposes, and already has sported into several marked varieties.

In its home or headquarters on the Scandinavian Mountains, the Norway Spruce becomes a fine, lofty tree, one hundred or one hundred and fifty feet high, with a diameter of two to five feet. Its habit of retaining its branches, which spread out regularly on all sides, so as to give the tree a pyramidal appearance, is characteristic of the whole family. These limbs are longest near the base, and extend horizontally; the upper ones are shorter, and at first drooping downward, at length sweep-

ing upward, except the terminal twigs, which again droop downward, bearing their long, pendent, shining cylindrical cones.

The timber is, hence, inferior for boards, because of the many knots and holes, but it is strong, elastic, and not very resinous—in commerce it is called "White Deal."

This is one of the few foreign Spruces extensively cultivated in California, and it proves hardy and ornamental.

OTHER ORIENTAL SPRUCES.

The other Oriental Spruces worthy of brief mention are *Picea Orientalis*, found on the mountains near the Black Sea, *P. Smithiana*, a large tree forming forests on the mountains of Farther India, above the Sacred Deodar Cedar; *P. polita*, the "Tiger's-tail Spruce," of the mountains of Japan, and planted by the Japanese around their temples, at Yokohama; and *P. obovata*, the distinctly Siberian Spruce, that flourishes near the Arctic Circle as a mere shrub.

Other trees often called Hemlock Spruce, or simply Hemlock, have been lately separated from the True Spruces upon abundant characters, and erected into a genus called by a Japanese name—*Tsuga*—from one of its chief species growing on the sacred Fusi-Yama. Representatives of this genus are found on both continents at less elevations, or in more southern latitudes than the True Spruces.

PICEA, Link.

TRUE OR TYPICAL SPRUCE.

True, Typical Spruces are distributed from shore to shore of the American continent and from tide-water pools to alpine peaks—the mountain species predominating.

As we should expect from the discussion in early paragraphs of this report, the three principal mountain ranges of North America—the Rocky and its two flankers, the Alleghany and Pacific Ranges, with their branches and detached outliers—are inhabited by the greater number of species, four climbing to the vicinity of perpetual snows, and five others on middle altitudes mostly in wet localities; while of the two remaining, one extends across the continent from ocean to ocean, and the other is local in the tide land forests of the Northwest coast.

Let us consider the widest distributed species first, as being decidedly typical, since the very fact of its inhabiting so varied and far removed regions argues its inherent strength and adaptedness—always the best evidence of a good species.

8. Picea laxa, Sargent. (*P. alba*, Link.) White Spruce.

This peculiar American Spruce is dispersed all across the northern part of the continent from the coasts of Newfoundland and New England, the northern peninsula of Michigan, and the lake regions of Montana, to the coasts of British Columbia and Alaska, while northward these forests are united and the species dwarfed to low shrubs, extending to the frost-bound shores of the Arctic Sea.

Its headquarters of best development are in the Flathead region of

Western Hemlock —

No. 8.—Bearing branches from near Portland, Oregon, showing cones and small male flowers, the 2-ranked leaves, a cone scale, leaf, and a pair of winged seeds, enlarged.

tree of the region, and is largely manufactured into lumber and into charcoal and fuel. It is noteworthy that in northern Montana this species and the closely allied White Spruce approach each other on the same latitude, but they never mingle, the Engelmann Spruce growing always at higher and drier elevations.

This royal Spruce approaches the limits of California on the north, within one hundred miles (and is, perhaps, much nearer), being found on the neighboring peaks of the Cascade Range, in Oregon. On the south it approaches within one hundred and fifty miles, being found upon the summits of Mount Graham, in central Arizona, and Mount Agassiz, the highest peak of the San Francisco Mountains, in northern Arizona.

In April of 1879, the writer explored the summit of Mount Graham, and in September, 1884, Mrs. Lemmon and myself twice ascended the lofty Mount Agassiz, finding thereon, bordering the great extinct crater, several fine specimens of this interesting tree, eighty to one hundred feet high, and two to three feet in diameter.

The bark is thin, about an inch thick, scaly, and reddish brown; the limbs are few, large, longest ones at the base, and widely expanded; the numerous secondary branches, with their finer branchlets decorated with the pendent brown cones, and clothed with the dark green, abundant leaves, appear like outstretched plumes of wondrous design.

The male flowers of the Engelmann Spruce appear in the early spring from the ends of the twigs in clusters, each of many stamens on a long receptacle forming a spike-like compound flower one half to one inch long, and half as thick, the whole at maturity raised out of the half dozen large involucral bud scales.

The fruit or cone dependent from the ends of other thick and short branchlets on the same tree (monœcious) is, during growth, royal purple in color, becoming at maturity reddish brown, cylindrical, and two to three inches long; when the scales are expanded, the cone is elliptical and an inch or more in diameter. The scales are rather fleshy, obovate, obtuse, with a minute spatulate, fimbriate bract on the back of each. The upper edges of the scales are scarious, wrinkled, and slightly erose dentate, seed a line long, ruby brown, with comparatively large wings, obliquely obovate, and two to four lines long, convex, and shining.

The leaves are thick set all around the branchlets, six to eighteen lines long, one half to one line wide, linear, obtuse or acute, strongly keeled above and below, making them quadrangular with four to six longitudinal rows of white dots (stomata), in the deep furrows each side of the keels—less below than above.

The leaves—like all the *Piceas* and *Tsugas*—are articulated or jointed upon peculiar foot stalks an eighth of an inch high, and which are so hard and persistent as to give the impression that they are abortive limbs, but upon slicing them with a sharp knife the origin of these foot stalks is found to be in the bark or epidermal fibro-vascular bundles, with no ligneous fibers from within—hence they are analogous to the prickles of a rose; though unlike rose prickles, these Spruce prominences bear each a terminal leaf.

In preparing botanical specimens of the two genera of Spruces—the *Picea* and *Tsuga*—another peculiarity of these leaves is discovered: they speedily separate from the foot stalks and fall away, so one has to pre-

serve them by special effort; scalding the fresh specimens in hot water will cause the leaves to remain slightly connected.

NOTE.—The *Picea Engelmanni* commemorates the services to American botany rendered by the late distinguished Dr. George Engelmann, of St. Louis, Missouri, being so named by its discoverer, Dr. C. C. Parry, lately deceased.

Dr. Engelmann, deceased February 4, 1884, had been a close student of American flora for fifty years, and our literature teems with his ably written articles. Chief of these are his monographs upon its obscure families of Cuscuta, Carex, Cacti, Euphorbia, Mistletoe, and Vitis, with especially his elaborate determinations of our most important forest trees —as the Oaks and Cone-bearers—hence it is most fitting that this Spruce, one of the noblest of them all and crowning the forests of our chief mountain range, should bear the honored name of Engelmann, recalling to men as long as the study of trees occupies their attention, the memory of a profound student and lover of American trees. (See Illustration No. 2.)

11. PICEA PUNGENS, Engelmann. (*Abies pungens*, Parry.) Blue Spruce.

This is a much less distributed species of Spruce than any of the preceding, being found only on the mountains near the source of the Big Horn River, in Wyoming, and neighboring mountains in Colorado and Utah. It affects the borders of streams and wet places, at elevations of six thousand to nine thousand feet, and attains the height of one hundred to one hundred and fifty feet, with a diameter of two to three feet. It never forms forests of itself nor ascends to the elevation of its neighbor, the Engelmann Spruce. It closely resembles the latter, but has acute or pungent leaves, which are less flattened, and bluish green—from the abundance of stomata (suggesting the popular name). The cones are longer, cylindrical, with undulate, retuse or notched scales and minute bracts, with larger, broadly winged seeds.

Discovered and introduced into cultivation, also, by the late Dr. Parry, under the name of *Abies pungens*.

12. PICEA SITCHENSIS, Carrière.

THE GREAT TIDE-LAND SPRUCE.

[See Illustration No. 3.]

This, the first of the Spruces named that undoubtedly reaches within the limits of California, is a remarkable species, with the habit of a Cypress, affecting low, wet, swampy grounds. It is local on the northwest coast, from Alaska southward to Cape Mendocino, California, and extending not more than fifty miles inland. It becomes, in its headquarters, near the mouth of the Columbia, a large tree of great economic value.

It reaches a height of one hundred and fifty to two hundred feet, with a straight, nearly limbless trunk in forests, and is six to eighteen feet in diameter. At its locality of greatest development it forms continuous forests of great density, fifty miles wide, but in the extensions north and south it is narrowed to diminishing points. Being of excellent lumber qualities, and very accessible, it is being speedily removed and manufactured into lumber for many uses, as it is highly prized.

On frequent occasions, during past years, the writer has visited the locality of the Tide-land Spruce, along the coast of California, and last season we made a special pilgrimage to its locality of greatest development, the Columbia River region, and the great forests of Puget Sound. Here this tree may be seen in all its magnificence. Tall, straight, limb-

less for two thirds of its height, it at once attracts the practical eye of the lumberman, and for that reason would be speedily exterminated were it not for the fact that it seeds readily, and the moist climate constantly promotes renewal.

The bark is thin, black, and scaly; the limbs of trees in open situations are few, long, and large, with persistent branches. The male flowers are axillary, or sometimes terminal, on the ends of last year's branchlets, with an oblong, stamineal column three fourths of an inch long, its short stipe surrounded by numerous large bud-scales; the stamens with the large double anthers, peculiar to the Cone-bearers, are terminated by a large, inflexed, orbicular crest. The female ament becoming the fruit or cone, at maturity, which is in September of the same year, is terminal upon stout, short branchlets, and is varied in size according to locality of the tree; being cylindrical or oval, and one and one half to two and one half, or in favorable situations, even three inches long, and three fourths or more than an inch in diameter, pale yellowish; the oblong scales a half inch long, thin, at maturity divergent from the axis, obtuse, ridged and denticulate, each with a half as long, concealed, lanceolate, denticulate bract on its back, and two small black seeds with narrow wings on its upper side, in deep excavations.

The leaves, five to eight lines long, are closely set all around the branchlets on raised footstalks, from which they separate in age, leaving rough branchlets, as in the other species. They are quadrangular from the presence of keels or ribs above and below, but these ribs are not so prominent as in the Engelmann Spruce and they have more—eight to ten—lines of stomata on the upper side in each of the two furrows. On young trees the leaves are long, narrow, and sharp pointed; on older ones they are shorter and less acute, or even obtuse.

The Tide-land Spruce being so accessible to early voyagers was collected by the first visitors to the northwest coast, and it has received a dozen scientific names, as it was classed in different ways. At last separated from the other Spruces by the French botanist Carrière and named for one of the localities of its first discovery on the island of Sitka.

The light, soft, straight-grained wood of a light brown or reddish color, gives it the name, among lumbermen, of Red Spruce. Large quantities are cut in the accessible regions, and the demand is always brisk at high prices. It has been grown readily from seed and no doubt could be utilized in reforesting our denuded coast regions.

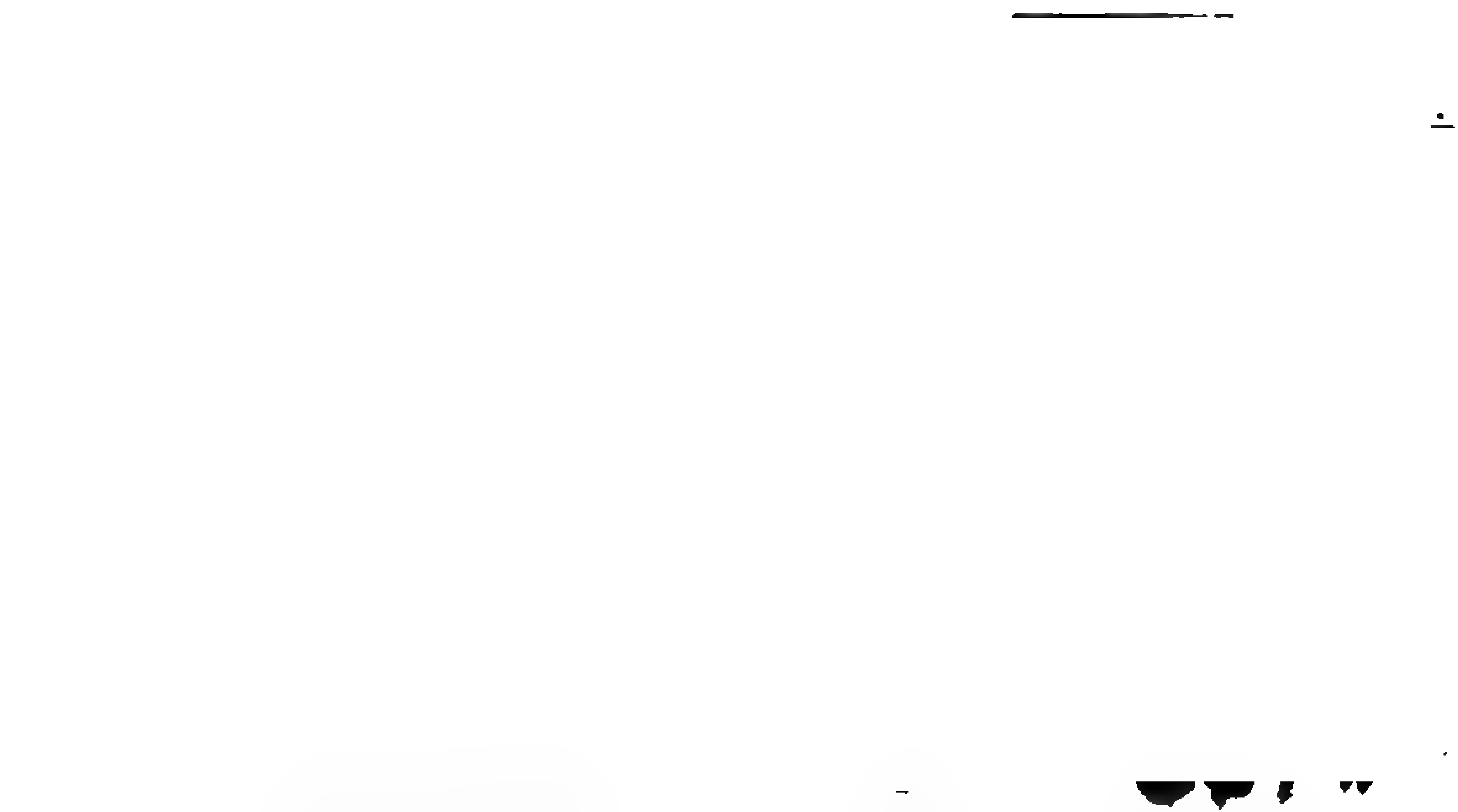
13. Picea Breweriana, S. Watson.

BREWER'S, OR WEEPING SPRUCE.

[See Illustrations Nos. 4, 5, and 6.]

Last and most local and sequestered of the *Picea*, or Spruces, and therefore but recently discovered, is the Brewer's or Weeping Spruce, of the Siskiyou Mountains. Being a peculiar and prospectively a very valuable tree for ornamental purposes, and withal inclosed by the limits of California, several attempts have been made by the writer, in years past, to reach its almost inaccessible home on the bald ridges crowning the summits of the lofty Siskiyou Mountains.

A few paragraphs descriptive of the topography of this region—affect-



No. 11.—Fruiting branch from a tree near Mount Shasta. The long strap-shaped cone bracts, both sides of the cone scales, and a pair of the winged seeds displayed in place. Photographed from a painting by Mrs. J. G. Lemmon.

ing and governing as it does the whole character of the contiguous forests—will be pertinent at this juncture.

As in the southern part of California there are several steep cross ranges extending from the great Sierra to the Pacific, so in northern California and the contiguous region of Oregon, there are a series of very steep cross ranges, commencing with the Trinity Mountains crossing from Shasta westward, the Siskiyou come next, then the Rogue Mountains, lastly the Umpqua Range, forming the southern rim of the great valley of western Oregon, threaded by the Willamette River.

Such cross ranges, beginning with promontories in the sea and extending into the interior, rising as they proceed, must necessarily separate and conduct currents from the great ocean of western wind and direct them, more or less, successfully upon the high, interior, long ranges parallel with the Pacific Coast. These currents of atmosphere are, of course, on different degrees of latitude as distance is gained northward; and each current, one after the other, will be more and more fitted to receive, and does receive, more moisture from the warm Japan ocean current that bathes the northwest coast. These conditions, added to the more profound factors accounting for the present location of plants where they now are, by their attempt in the past ages to return northward after the retreat of the great ice sheet (described in earlier paragraphs), conspire to locate peculiar, often extremely local, remnants of development impluses upon these fateful cross ranges, stranded there in the last throes of extinction, if so be that the earth continues to increase in warmth through coming ages.

Hence, we find upon nearly every one of these ranges peculiar trees, and numberless other smaller plants of extremely local habitat.

On the Trinity Range, near Shasta, is found the peculiar and extremely local *Pinus Balfouriana*, the original type of Jeffrey's valuable discovery; also, there is found the very peculiar, and perhaps to be separated, typical form of *Pinus Jeffreyi*.

On the Siskiyou is stranded, as stated, the Weeping Spruce, and a peculiar Oak, with no one knows what other solitary and strange plants.

On the Umpqua Range is a remarkable growth of the Great Sugar Pine, the largest trees of its species known, and, fortunately for him, the first discovered by Douglas after his long quest of two years. It should be stated in this connection, that although the Sugar Pine is found elsewhere, particularly from end to end of the Sierra Mountains, yet here, on this outlying cross range, it is treated to an unprecedented amount of moisture, which perhaps accounts for its unwonted development. With an equal amount of moisture, what might the extensive Sierras display in the way of Sugar Pine?

To the causes discovered may also be referred the remarkable presence of the curious and extremely local *Abies venusta* (known as *A. bracteata*), on the Santa Lucia Mountains of Southern California; also, on this, and similar, more southern cross ranges, the presence of the Big-cone Pine and several Oaks.

And the great giants of earth's vegetation, the California "Big Trees," are stranded upon the southwest slope of the southern end of the high Sierra, through the operation of precisely the same laws of development and limitations of environment, to wit: the attempt on the part of a struggling remnant of a great family to return home northward over

impassable mountain barriers, these barriers reinforced by forbidding atmospheric conditions.

During the years 1887 and 1888, while undertaking to study the Pine family, it was found necessary to follow some of the species down into Mexico, and others over into Nevada and Utah. So, this season, in order to understand the other families of our noble Cone-bearers, it was necessary to visit them at their headquarters of best development.

Several of our most valuable trees are native to the forests about Shasta and in the Siskiyou Mountains. Others have their headquarters in more northern ranges—the Rogue and the Umpqua Mountains—and especially in the noble forests around Mounts Hood and Tacoma; while the broad, dense, interminable woods, "Where rolls the Oregon," and the primeval forests of Puget Sound, contain colossal growths of Douglas Spruce, of giant Arborvitæ quite as large, majestic Firs of lofty height, magnificent and rare Spruces, lovely Hemlocks and Yews—each species of which drips down with small representatives along both the Coast and Sierra Ranges far within the limits of California.

SEARCH FOR THE NEW SPRUCE.

Determined upon visiting the home of the lately discovered and solitary Spruce, we proceeded to the vicinity of the Siskiyou Mountains, arriving September 26, 1889, at Cole's Station, to find the cañons all ablaze with fire and filled with smoke. There was no alternative but to pass on through the stifling smoke, a blazing tree ever and anon crashing beside the sweeping train.

At Grant's Pass we changed for a freight train that would traverse the Umpqua Mountains by daylight, hoping to find this range explorable, for we wished to leave the line of railroad and visit the region of forest near the headwaters of the Umpqua River, the very locality where the heroic Douglas first "saw with my own eyes the Grand Pine," which he had been seeking for two years (and which he had already named *Pinus Lambertiana*, in honor of his patron and friend, Lambert), upon the meager data offered by a few seeds discovered in the tobacco pouch of an Indian on the Columbia River.

But this long coveted trip was denied us, and we must either return or pass on. We chose the latter alternative and passed on to visit the Fir forests around the base of Mount Hood, of which mention will be made in proper place.

SECOND ATTEMPT.

In October we found the forest fires so far lessened as to warrant the hope for successful examination of the Siskiyou Mountains in detail. As the northern slope is much more densely clothed with timber than the southern, and, also, is much easier of ascent, we proceeded to Grant's Pass, situated amidst groves of Garry's Oak and of the gorgeous Red-fruited Madrona, and there established headquarters for a fortnight.

Short preliminary excursions were made into the range on the east, where some very fine Madrona trees, four to six feet in diameter, were photographed; also, some large Yew trees were seen, but they were too deeply immersed in the forest to be successfully pictured.

The special trip in search of the Weeping Spruce was commenced

October 23d, and was expected to occupy about five days. It involved, first, about sixty miles by private conveyance through the Pine forest covering the whole face of the country westward from Grant's Pass and forming the broad lower valley of the Rogue River.

Passing Applegate and Kirbyville amidst Yellow Pines of especially symmetrical shape, and of the characters most nearly approaching the variety I have indicated in my Pine monograph as *nigricans*, or Brown-bark Pine, we soon reached the locality of the early mining claims near Waldo. The surface of the earth all over several valleys was collected into heaps by the miners, and now these mounds were blossoming with native plants helped by the accidental cultivation to new developments almost disguising their lineaments.

Throughout the valley of the Rogue River the principal arboreal vegetation is confined to the two Pines: the Yellow, with the Sugar Pine on the higher slopes; two Oaks, Kellogg's and Garry's—the latter, a large tree with dense, shining foliage—an Ash of good size, and the ever beautiful Madrona, its bright orange red or madder red trunk and bared limbs, when seen only in sections through other trees, seem the bared body or the out-reaching arms of a human figure, but its great clusters of scarlet berries, generally abundant on every tree, and at the time of year we were among them, half covered by the large, elliptical, shining, parti-colored leaves, gives a character of richness and loveliness to the Madrona that is incomparable in all our forest flora.

Quite unexpectedly, a few fine trees of *Pinus tuberculata*, or "Knob-cone Pine," were met within a moist locality on the general level of the valley; not as is their usual habitat, on a high, sunny ridge. This is nearly the most northern locality noted for this species, the other being the valley of McKenzie's River, in central Oregon.

It is worthy of mention here, that two of our most wonderful California plants—the *Sarcodes* (the snow plant) and *Darlingtonia* (or pitcher plant)—supposed to be limited to the Sierra Nevada Range, are found also on these northern cross ranges, though in but few localities: notably, on Eight Dollar Mountain of the Rogue Range. The *Sarcodes* (or snow plant) is also found on the San Bernardino Mountains, and other high, cool, fir regions southward.

Near Waldo we reach the point where the wagon must be abandoned and the trail taken over the western end of the Siskiyou—looming up, lofty, steep, and forbidding. Knowing this was to be a hard trip—too rough for a lady—Mrs. Lemmon was persuaded to remain at Grant's Pass and sketch a branch of the Regal Madrona, while, with an assistant, I should prosecute this hazardous journey without my almost ever constant sharer in explorations.

Disposing of the wagon in the corral of a pioneer farmer, and saddling our horses, we started out in the gray of the early morning, taking the trail towards "Happy Camp."

Was there ever a good, pleasant mountain trail? Only those constructed with much labor, about Yosemite, that I have ever seen; however, this might have been worse, and yet passable.

By nine o'clock we had reached the shoulder of the first real mountain elevation, and soon after we entered a forest of Red Fir, occupying a valley so hidden as to be totally unsuspected a half hour before. We had been walking, or rather climbing, for some time past, leading our animals, and this stretch of flat land was most welcome. Mounting,

we rode leisurely along amidst a young growth of Red Firs (*Abies magnifica*) that is most charming in its wealth of symmetrical trees—always of the same shape and perfection in trees of the same height.

Like the *Araucarias* of our lawns, introduced from South America, the Fir family is distinguished by the regularity of its many whorls or layers of limbs, and the two species of Red Fir have such short and close clasping leaves that the branches even to the last terminal twigs are fully seen in gauzy loveliness, half veiling the sky.

Here, too, bordering the murmuring streams, and rising like pyramids of verdure to mark where repose some Hymadryad, perhaps, is found the most universally accepted ornamental tree of our local forest production—the *Chamæcyparis Lawsoniana*, or Lawson Cypress, everywhere introduced, and always giving satisfaction on account of its habit of forming a broad cone of verdure, and of disposing its branchlets in little fan-like sprays of horizontal, drooping foliage.

Crossing this forested valley and climbing up by zigzag trail over ridge after ridge of splintered rocks, about noon we reach the summit of the Siskiyou (within the limits of California) and look forth over an extended landscape. Northward, over forest and plain, rose unnamed peaks of the Umpqua Range; northeastward, the long line of peaks that told where stretches the Cascade Range, with the near Mount Pitt in ghostly robes following the vanishing procession; westward, a purple bank of haze told where lay the Pacific only eighteen miles away, but its face veiled by the coast forests. We turned our gaze southward.

"There it is, Wheeler; and what a beauty!" I cried.

"Yes," said my companion; "there is Shasta in all his glory!"

But I was looking through a vista of the thin forest and, a moment after, was standing bareheaded before the new Weeping Spruce.

The tree is much taller, slimmer, and much more striking and beautiful than I had expected, having read only a meager botanical description.

Only a few trees were found, and these scattered about among other trees on the rocky crests.

The fallen trunk of the tree felled by Mr. Brandegee to obtain a specimen block for the Jessup Museum at New York was noted, its bare limbs with the rough branchlets plainly proclaiming that a member of the Spruce family, with its peculiar characters, was before us.

No fruit of the season was found, save one cone which a squirrel had cut down and partly denuded of its scales. This piece of a cone I secured, and the four seeds remaining have been put into the hands of a seedsman in Oakland to propagate.

Hastily putting the photographic apparatus in order—for clouds were forming and wind threatening—I selected a pair of graceful trees and exposed the plate, securing the first picture ever taken of this rare Spruce. The remaining plate was used to catch a lone tree of great beauty, with my assistant and his horse standing near it, finishing the exposure just as the gathering storm reached the mountain and the tree tops commenced swaying in the wind.

A new Shrub Oak was found in the same groves with the new Spruce, and specimens secured.

Excellent specimens of the long, slender branchlets of the Spruce, six to eight feet long, and not larger at the butt end than an ordinary lead

No. 10.—DOUGLAS SPRUCE (*Pseudotsuga taxifolia*). An upturned tree lodged between two others of the same species; with workmen. Photographed by J. G. Lemmon.

pencil, and of the short upper branches of one of the trees loaded with last year's empty cones, were secured.

These trophies were carefully placed in sacks and tied behind the saddles, to be conveyed to headquarters in Grant's Pass, where they arrived in good condition and were successfully photographed.

EXTENDED DESCRIPTION OF PICEA BREWERIANA.

As stated elsewhere, the Siskiyou Mountains extend from the Cascade Range as a divergent spur westward nearly on the boundary of California, ending in a promontory on the Pacific.

The great height, five thousand to seven thousand feet, results especially in separating from the great sheet of western wind coming from the ocean, a distinct current of its warm, moisture-laden atmosphere, and directing it into the interior; also, like the other cross ranges, it opposes a high barrier across the course of plants migrating northward from tropical regions, as we have seen; and for these reasons we find the Weeping Spruce, the undescribed Oak—and no one knows what other solitary remnants of species—stranded upon the sides and summits of the Siskiyou.

There may be other points eastward on this range where this lone Spruce may be detected, as discussed hereafter, but up to date the only locality is a very limited one near the western end of the Siskiyou Mountains and on the southern side of the summits within the California line at an elevation of about five thousand feet.

There are not to exceed a few dozen individuals, all told, and they do not form a grove to themselves, but are scattered among other coniferous trees, such as Fir, Hemlock, Incense Cedar, etc. Search was instituted in vain to discover any sapling or seedling trees—though it is but fair to state they might have been found there had time permitted.

The trees range from one and one half to three feet in diameter and from fifty to one hundred, or rarely one hundred and fifty feet in height. They have the True Spruce characters of outline—tall, slim, tapering; the lower limbs longest and nearly horizontal, the upper ones sloping downward and outward, diminishing in size to the top, which terminate in nodding, swaying, short branches, generally decorated with pendent, finger-like cones.

But with these few points the resemblance to the other Spruces ceases. The primary branches directed outward are thickly set with branchlets that become elongated and pendent—two to eight feet in length—clothed the whole distance with short, divergent leaves. Persons desiring inch ropes of green for festoons or other decorations can find them here, ready made, but as soon as withering began every leaf would drop.

When the atmosphere was stirred—presaging the storm—these long, pendent tassels were swayed and tossed about in graceful undulations that were as surprising as pleasing to see, there upon the bleak mountain tops, amidst rigid limbed, motionless trees, and I could but regret that all my artist friends and tree lovers, especially my companion on so many botanical explorations, were not there to enjoy with us the rapturous exhibition.

The bark of this tree is thin and reddish, the timber white, tough, and elastic. Transported to other favorable situations, this might prove a valuable timber tree, and the experiment should be tried.

The cones are two and one half to three and one half inches long. narrowly cylindrical, attenuate at base, with several undeveloped scales; the minute bract on the back of the mature scales is linear oblong, about two lines long, denticulate, and one fourth the length of the scales, which are obovate, with thickish, entire upper edge; seeds one and one half lines long, brown, with an oblique, convex wing four lines long by half as wide. The leaves are dark green, six to fifteen lines long by one half line wide, sessile upon the persistent, one line high, base; obtuse, smooth and rounded on both sides, or carinate on one or both sides, slightly lined with stomata beneath on each side of the mid-nerve; the two longitudinal resin ducts close under the epidermis on the back.

PROBABLE EARLY DISCOVERY.

Many years ago a member of an engineering party that had been surveying for a railroad over the Siskiyou Mountains informed the writer that a curious looking tree had been seen on the eastern Siskiyou Mountains, near the Klamath River. He stated that the tree was low-headed as if cut off a few feet from the ground, and that the limbs were outstretched and bending downward with long, pendent branches, like a Weeping Willow.

Attempt was made repeatedly to visit the reported locality, but circumstances or illness prevented from year to year.

In June, 1884, Thomas Howell, of Sauvie's Island, Oregon, happened upon a Weeping Spruce in the western end of the Siskiyou Mountains, specimens of which he sent to Dr. Sereno Watson, at Cambridge, Mass.

Upon examination it proved a very distinct, undescribed species of *Picea*, and the doctor named it *Picea Breweriana*, in compliment to Prof. W. H. Brewer, now of Yale College, New Haven, a gentleman who, in connection with the early geological survey of California, had much to do with the botany of the State, especially being interested in our trees; hence it is eminently proper that the name of Professor Brewer should be thus associated with the forest trees of California.

This tree having decidedly weeping branchlets and found on the Siskiyou Mountains, although far to the westward of the first reported locality, may be the long lost Klamath weeping tree; but the low-headed character of that tree is entirely absent from this, and the original species may be waiting still for its discoverer.

TSUGA, Carrière.

HEMLOCK SPRUCE.

The trees called Hemlock Spruce, or simply Hemlock, have until lately been classed originally with the Firs; then they were separated with the True Spruces.

As late as 1875, Gordon placed them in a section of the "Spruce-Fir" family called "*Tsuga*, or those kinds with flat leaves, mostly glaucous below, and more or less two-rowed."

Previously, botanists had separated these trees from the True Spruces, Carrière, in 1855, giving the genus the name of *Tsuga*—precisely the Japanese name of their tree, meaning yew-leaved, or evergreen. Later. in his second edition of "Traite Coniferæ," Carrière found that the tree

so set off were separable into two genera, or rather that one species possessed so many divergent characters that it deserved generic rank, and, because he thought it resembled *Tsuga*, he gave it the almost unpronounceable name of *Pseudo-tsuga*, the False Hemlock. This peculiar genus is a product of West American development, and will come in for an extended description later.

The True Hemlock Spruces comprised in the botanical genus *Tsuga* are six in number, and their distribution is very peculiar. They are found in the northern part of both the grand divisions of the earth: two in Eurasia and four in America.

The Eurasian species are separated by nearly half a continent, the American species by a whole continent—a pair being distributed on each side of it.

The genus *Tsuga* (a Japanese word pronounced by them as if spelled "Soongá," with the accent on the last syllable), resembles the genus *Picea*, or True Spruces, in many respects, differing principally in having flattened sprays of foliage, the leaves mostly in two ranks instead of scattered, and petioled instead of sessile, with a single dorsal resin duct instead of two. The cones are smaller, and the seeds have one or two resin glands on their upper surface—in this last respect resembling the genus *Abies*, or Fir.

The resemblance of *Tsuga* to the *Pseudotsuga* is very slight indeed, and the naming of the latter genus, as if closely related to it, was a palpable error, besides introducing a formidable, almost forbidding term into our botanical nomenclature—as discussed later.

ORIENTAL HEMLOCK SPRUCES.

As stated, there are two species of Hemlock in Eurasia. Both are in Asia; one, the original *Tsuga*, clothing several mountains of Japan, including the sacred *Fusi-Yama*, at elevations of eight thousand to nine thousand feet, where it becomes large forests exclusively of this species, attaining a height of eighty to one hundred feet. Its timber is fine grained, of a yellowish color, and prized by the Japanese and Chinese in the manufacture of their curious wares; also, the Japanese plant it extensively about their temples. In many respects this Japanese species resembles our eastern American species.

The other Oriental Hemlock is found on several mountain ranges of India, notably on the southern slopes of the Himalayas, where it is enormously developed, becoming a tree six to eight feet in diameter.

According to Sir Joseph Hooker: "On the Himalaya this tree forms a narrow belt at an elevation of nine thousand to ten thousand feet on the south flanks of Kunchinginga, probably the highest mountain on the globe."

While it is one of the handsomest forest trees in India, its timber is of poor quality, soon perishing under exposure. On account of its fragrant odor the Hindoos called it by a name signifying pleasant smelling tree, and they use it largely for incense.

One peculiarity of this tree reminds one of our Weeping Spruce lately discovered, and it also reminds of some forms of the Douglas Spruce; that is, the drooping character of its limbs.

It is said that "its boughs ascend a little in the young trees, but are

horizontal in older ones, and from these the branchlets and smaller twigs droop in the most graceful manner."

It is worthy of note that these two Oriental Hemlocks are found at nearly the same height from sea level, though widely separated in longitude.

Both are cold weather plants and belong away northward. One is maritime and takes kindly to sea air and fogs near the tops of Japanese islands; the other is inland, stranded on the southside of the long range of the Himalaya; each confined to narrow belts of only a few miles in width, indicating extremely precarious conditions that must be adjusted to a nicety, or else, presumably, these species would become extinct.

This phase of development will be discussed further when we come to take up the American Hemlocks.

AMERICAN HEMLOCKS, OR HEMLOCK SPRUCES.

There are four species of Hemlock in America, training in two pairs: one pair on the Atlantic Slope, the other on the Pacific; one of each of these pair is maritime, the other interior and alpine. The maritime species has in each case a widely extended range, while the alpine species is extremely local.

13*a*. TSUGA CANADENSIS, Carrière. Canadian Hemlock; New England Hemlock.

This, the principal of the eastern Hemlocks, is found plentifully on the northern seaboard of New England and Canada, and has a few representatives as far inland as northern Michigan and Wisconsin. It affects the coldest parts of the country, and forms three fourths of the dense forests around Hudson's Bay; but strange as the statement may appear, the largest trees of the species are found on high mountains of the Alleghany Range.

This eastern Hemlock is the best known of all the Hemlocks, being freely planted in the East, as well as abroad in Europe and Australia. It is recognized at sight by its many long, ascending, plume-like branches, divided into small twigs, each clothed with dark green leaves in two ranks, and its small oval cones, about three fourths of an inch long, produced along the edges of the plumes like a fringe of acorn pendants.

Always beautiful when standing alone where it can expand, this tree becomes singularly unsightly when crowded in a swamp. Here, in yielding to the pressure of its environment and the attacks of its neighbors of the same species—always the most ruthless of enemies, since *all* are inherently fitted for the place which only *one* may be able to seize and hold—the tree becomes extremely dejected and with crippled members.

This aspect of decrepitude does not appear when the tree is allowed to develop at will, as on the edge of a forest or when planted in a lawn, where it becomes a mass of conical foliage of great beauty. The branches, nearly horizontal, spring out irregularly from the trunk, never in whorls; the branchlets bend gracefully outward and downward, the longest in the middle of the branches, dividing and sub-dividing into tiny segments, reminding one of the compound leaves of the Poison Hemlock of the Parsnip family, and this resemblance suggested the popular name "Hemlock" for these trees.

Alpine Western Spruce.

Hesperopeuce Pattoniana.

No. 9.—Fruiting branch from a tree near Webber Lake, Sierra County, California. A cross-section of a leaf, both sides of cone scales, and a pair of the winged seeds displayed. Photographed from a painting by Mrs. J. G. Lemmon.

The timber is of little value, owing to the many limbs that extend from heart to bark, making holes when the trunks are sawed; this not occurring in trees that drop their limbs early and close to the trunk, like the Sugar Pine.

14. Tsuga Caroliniana, Engelmann. Carolina Hemlock; Southern Hemlock.

The other eastern Hemlock is at once interior, alpine, and local, as noticed in the Himalayan species. It is a smaller tree, sparsely inhabiting dry, rocky ridges of the southern Alleghany Mountains, notably in the highest peaks of North Carolina and Tennessee. It resembles the northern species somewhat, and, until very recently, was not separated from it by the botanists.

In 1881 Dr. Engelmann published it under the above name, described from specimens (collected by Professor Gibbs, of Charleston), as distinguished by its larger, glossier, blunter leaves, and its larger cones with wide-spreading scales. These points, combined with its alpine habit, seem quite sufficient to indicate that the variation from a common type has been long continued and is sufficient for specific recognition.

This species has a homologue in the alpine species of the Pacific Slope, as the other eastern one—*Tsuga Canadensis*—has with the Pacific Coast species of wide distribution next to be described.

15. Tsuga Mertensiana, Carrière. Western Hemlock.

[See Illustrations Nos. 7 and 8.]

This is the widest distributed of the two Pacific American Hemlocks peculiar to the extraordinary forest development of the northwest coast, under the fostering power of the warm *Kuro-Siwa*, or Japan "Black River," bathing its islands and promontories, and the consequent saturated state of the trade winds crossing the ocean current and fanning the coast mountains.

The greatest development of this species is along the western slope of the Cascade Range, at low altitudes, where it attains the great size of one hundred to one hundred and fifty feet in height, with a diameter of five to twelve feet. From this headquarters of best growth, it extends northward, through the ranges of British Columbia, to Alaska, and eastward, along the cross ranges, to the Bitter-root Mountains of northern Idaho. Southward, it narrows to the Siskiyou and Coast Range Mountains, appearing sparsely along the latter as far southward as Marin County, California.

This large and important tree of the Northwest is so extensively distributed as to reach from its headquarters to points far within the limits of California; hence, it must be described in detail.

Even in California the *Tsuga Mertensiana* attains the height of one hundred to one hundred and twenty feet, with a diameter of four to six feet. The bark is unusually thin, sometimes thick, reddish brown; the sap-wood nearly white, the heart-wood light brown or yellowish, hard, close-grained, but not strong, making coarse, inferior lumber; but the bark is rich in tannin, and is the principal material used in the Northwest for preparing leather.

The primary branches are few, not in regular whorls, but arising

alternately, the upper shortened so as to make the trees flat topped if in the forest.

In open situations the general outline is fusiform, with the long main branches ascending, feathered on both sides by numerous branchlets in two ranks, the middle ones the longest; and all again dividing into short, slender, hairy ultimate branchlets in two ranks, the latter drooping gracefully and decorated with pendent cones, that when growing are bright purple, at maturity light brown and oval, about three fourths of an inch long, the scales ultimately expanding so that the cone is globular at the time of releasing the seeds.

The cone scales are oblong, convex, with thin entire edges, the bracts, closely attached to the back of each at their base, are very small, pubescent, three-lobed; the lobes obtuse; the scales and bracts firmly attached to the cone axis by strong, ligneous fibers; seeds one to one and one half lines long, angular, with one or two resin glands on the surface; wings relatively very large, one quarter to three eighths of an inch long, widest below, thin and convex, comformable with the scale; cotyledons three or four.

The male flowers are in clusters of six to eight, terminating the short (one to two inches), hairy branchlets of the season, the large tomentose bud scales, in time releasing the spike-like head, two to three lines in diameter, of crested stamens; the whole high raised out of the bud scales on a slender stipe three eighths of an inch long at maturity.

The leaves in two ranks are linear, four to ten lines long, flat, about three fourths of a line wide, slightly keeled below, entire or minutely spinulose; cerulate near the tip, shining above; when young, white beneath with longitudinal stripes of stomata on each side of the keel; a cross-section reveals a single resin duct. As soon as withering commences, the leaves promptly separate from the prominent leaf base, which is brown, shining, convex, and abruptly truncated, half hidden by the long white hairs of the young branchlets.

This Western Hemlock, as seen, is the analogue of the eastern *Tsuga Canadensis* and resembles it in its widespread distribution and in the fineness of its foliage; but ours becomes a much larger tree, with finer grained timber, redder bark with richer tanning qualities, etc.

Carpologically it is distinguished by more elongated cone scales and consequently much longer seed wings.

The species is also closely allied to *Hesperopeuce*—next to be described—in having a single resin duct of the leaves, in the form of their stipitate male flowers and the glands of the seed; but differs in having two-rowed, flat, obtuse leaves, stomatose beneath; the pollen grains discoidal; the cones much smaller; the scales never strongly reflexed at maturity, etc.

16. Hesperopeuce Pattoniana, Lemmon.

(*Tsuga Pattoniana*, Engelmann.)

PATTON'S, OR ALPINE WESTERN SPRUCE.

[See Illustration No. 12.]

This, the last of the Spruces to be described here, is a fine representative of strictly alpine arboreal vegetation, and hence limited to the

upper points of forests that creep up along glacier beds and volcanic ravines, close to the perpetual ice.

As but few of our mountains rise into this alpine region, so there are but few localities where these trees may be found fringing the upper edge of the coniferous forests, notably: around the snow cap of Mounts Rainier, Hood, Pitt, Scott, Shasta, Lassen, Sierra Buttes, Haskell's Peak, Webber Peak, Mounts Lola, Tallac, Silver Peak, Mounts Lyall and Whitney—in short, almost every peak that rises to the region of perpetual snow in that long range called the Cascade in Washington and Oregon, and Sierra Nevada in California.

Its northern limit in British Columbia is at an elevation of only eight thousand feet; on Mount Tacoma (Rainier), nine thousand feet; and on the slopes of Mount Hood, nine thousand; at Shasta, nine thousand two hundred; at Mount Lyall, nine thousand five hundred; and ten thousand feet near Mount Whitney, where it disappears.

In many of these regions the lower part of the belt mingles with other trees, such as Red Silver Fir, Mountain Pine, or Aspen Poplar, and here the trees often attain a large size, six to twelve feet in diameter at base, tapering to a slender shaft, eighty to one hundred and fifty feet high; but in strictly alpine situations the trees are reduced to low conical masses of foliage or prostrate creeping shrubs.

In favorable situations the lower limbs are retained and become long, out-reaching, and spreading over the mountain slope for many feet; the upper limbs are irregularly disposed, not whorled; they strike downward from the start (so that it is almost impossible to climb one of the trees for the want of foothold), then curving outward to the outline of the tree; they are terminated by short, hairy branchlets that decline gracefully, and are decorated with pendent cones which are glaucous purple until maturity, then leather brown, with reflexed scales.

The main stem sends out strong ascending shoots, the leading one terminating so slenderly as to bend from side to side with its many purple pendants before the wind, and shimmering in the sunlight with rare beauty.

This Alpine Spruce, not strictly a Hemlock, was first discovered in 1852, by that sharp-eyed Scotch gardener, John Jeffrey, who was sent to this country by Edinburgh florists to collect seeds of forest trees in the wonderful region of the Northwest, but a few years before explored by David Douglas with rich results.

This tree, with three other new species, rewarded the search of this explorer, and was described by Professor Balfour and published anonymously in what was called the "Report of the Oregon Committee," under the name of "*Abies Pattoniana*," a name given to it by Jeffrey, in compliment to Mr. Patton, a botanist of the "Cairnies," in Scotland.

Subsequently, Andrew Murray collected it, and named it *Abies Hookeriana*, in honor of Sir William J. Hooker, the renowned botanist of England.

In 1855 Dr. J. S. Newberry, in elaborating the botanical parts of the results of explorations for a railroad route from the Sacramento Valley to the Columbia, described and figured this tree under the name of *Abies Williamsoni*, so named in honor of Lieutenant R. S. Williamson, commanding the expedition.

The species bore one or the other of these three names until 1880, when Dr. Engelmann revised the whole tribe of ABIETINEÆ, or pitch trees, for

the botany of California, in which he referred these Spruces to the genus *Tsuga*, restoring to this species the specific name of *Pattoniana*. I now separate it as the type of another genus for reasons shown later.

BOTANICAL CHARACTERS.

The fruit or cone of the Alpine Western Spruce (*Hesperopeuce Pattoniana*) is oblong cylindrical, two to three inches long, purple until maturity, then light brown; scales becoming strongly reflexed at maturity (see illustration), numerous, nearly all of the same size, broader than long, one half inch wide, striate, with a wavy or entire, thin, rounded edge; the bract on their backs closely clasped, small, three or four lines long, spatulate with an attenuate tip; seeds two lines long, angular, with resin vesicles on the upper side; wings large, elliptical, one fourth to one half inch long, one half as wide, thin, and convex; leaves scattered, quadrangular (not in two ranks and flat as in the Hemlocks), linear, five to fifteen lines long, a half line wide, acute, strongly keeled above and below, narrowed to a slender petiole, which is promptly deciduous when withering, from the persistent leaf base; the latter less prominent, convex, and shining than the other species; male flowers very small, in clusters at the ends of the branchlets of the season, globular, three to four lines high, slightly raised out of the bud scales.

A peculiarity of the Alpine Western Spruce is observed also in the Sub-Alpine or Mountain Pine (*Pinus monticola*), *i. e.*, the cone scales at maturity open out and turn firmly back, displaying their striated inner surface (see illustration). The leaves, never in two ranks, are often so clustered as to recall the foliage of *Larix* (Larch), as do also the cones resemble those of that genus.

Dr. Engelmann in "Botany of California," page 121 (1880), separates this species from *Tsuga Mertensiana*, as a section characterized thus: "Leaves mostly convex or keeled above, acutish, stomatose both sides; pollen grains bilobed; cones larger—*Hesperopeuce*."

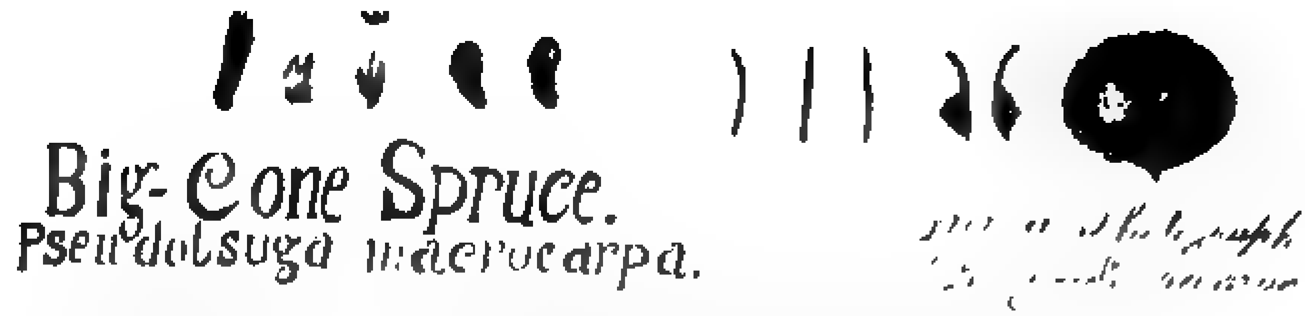
The other species he places under *Eutsuga*, characterized by: "Leaves flat, obtuse, stomatose only beneath; pollen grains discoidal, cones small, an inch long or less."

The characters indicated are fully substantiated by specimens recently collected at various stations in California and Oregon, and, taken with the other features noted, they indicate clearly a wide separation of this Sub-Alpine Spruce from *Tsuga*.

Hesperopeuce is the fourth genus covered by the somewhat vague term of Spruce. The propriety if not the scientific necessity of separating it from *Tsuga* may be justified upon the ground that the Conifer family is so large and the necessity for dividing it into groups for convenience of comparison is so apparent, that comparatively slight differences—so they are fundamental—must be taken for generic distinctions, as in the case of *Tsuga* taken from *Picea*, *Libocedrus* from *Thuya*, *Chamæcyparis* from *Cupressus*, and the like. In this case, however, several fundamental characters are not wanting for the establishment of *Hesperopeuce*, a term coined by Dr. Engelmann and meaning "Western Spruce."

It is not strictly a Hemlock in appearance or characters. It resembles the True Spruces, and also the Larches, but is abundantly distinct from all. It is in fact as here classified—*sui generis*.

Cones of a Spruce collected by Rev. E. C. Smith, of Seattle, Washing-



No. 12.—Bearing branches from trees in the limited region of San Bernardino Mountains, California. The long strap-shaped bracts, a leaf, and a winged seed, enlarged.

ton, on the slopes of Mount Rainier, August, 1889, are very narrow, and not above one half inch thick; two to two and one half inches long, attenuate towards the apex, the numerous, puberulent scales more rigid and firmer on the outer border than the typical form, and not so strongly reflexed. Leaves short, scattered or almost fascicled at the ends of the slender, short, tomentose branchlets, and not convex above, but flat and channeled; dorsal resin duct small.

This Spruce, while differing from true *Picea* greatly, and less so from the present species, may serve to carry this new *Hesperopeuce* back into *Tsuga* when more of its characters are disclosed; in that case requiring a great enlargement of generic characters in order to admit these aberrant forms, which in the dim past may have been as long separated as they, and as well entitled to generic rank.

This step is not taken thoughtlessly, but only after a careful study in the homes of this alpine inhabitant of the western peaks, as well as of its allies, and I think that no botanist acquainted with the Hemlocks of both the Old and the New World will, with this alpine tree before him, doubt that it has more than a remote connection with that well known and very definite group of trees, the Hemlocks.

PSEUDOTSUGA, Carrière.

FALSE SPRUCE.

This is a small but very important genus of two species peculiar to the forest development of the American Northwest.

The botanical name of this genus—*Pseudotsuga*—was coined by the French botanist, Carrière, and is most troublesome to us who are trying to popularize a correct knowledge of our trees. Examination of the distinguishing characters of the genus reveals the fact that the objectionable name was improperly bestowed anyway, for the plants but very slightly resemble the genus *Tsuga*, being much nearer to *Picea*. Some of the differences between *Pseudotsuga* (for so we must call it, there is no recourse) and *Tsuga* may be briefly noted.

The timber of the former is strong and durable, of the latter, weak and brittle; the bark of the former is mostly thick and deeply furrowed, of the latter, thin and flaky; the cones of the former are sub-terminal, of the latter, terminal; the cone bracts of the former are long, exserted, and three-parted, of the latter, short, concealed, and obtuse; the branchlets of the former are smooth, with flat leaf scars, of the latter, roughened by hard, persistent leaf bases; the seeds of the former are devoid of resin vesicles, which are present upon the seeds of the latter; the leaves of the former have two dorsal resin ducts, extending from end to end; those of the latter have but one.

There are two species of False Spruce—*Pseudotsuga taxifolia*, the "Yew-leaved," or "Douglas Spruce" (properly called by the latter name), and *Pseudotsuga macrocarpa*, the "Big-cone False Spruce," the latter usually treated as a variety of the former, but evidently distinct, as shown hereafter.

17. PSEUDOTSUGA TAXIFOLIA, Britton.

(*Pinus taxifolia* and P. *Douglasii*, Lambert. *Pseudotsuga Douglasii*, Carrière.)

DOUGLAS SPRUCE.

[See Illustrations Nos. 9 and 10.]

The Douglas Spruce is the special product of the favoring forest conditions of the Northwest, being a component part of, and precisely coextensive with this great forest development, in all its vast extent, from the Pacific Coast to the Rocky Mountains, and from British Columbia to Central Mexico. No other tree is more manufactured in the West, and none other is found to possess more value for many purposes than the Douglas Spruce. The Sugar Pine, being comparatively scarce and very fine finishing lumber, commands a much higher price, and the Yellow Pine of the West yields a better lumber for many purposes, while the famous Redwood excels all other trees, nearly, in the beauty and general serviceableness of its lumber; but for cheap, strong, durable timber, the Douglas Spruce recommends itself to builders and manufacturers in many ways.

Its headquarters of greatest development is an elongated coast region stretching from the north end of Puget Sound to Cape Mendocino, and from the seacoast to the Cascade and Sierra Nevada Range.

In favored localities of this belt the Douglas Spruce forms almost exclusive bodies of dense forest composed of tall, straight, thick-set trees, making jungles of excessive gloom and grandeur.

Its accessibility from the ocean through the many branches of Puget Sound, the Columbia River, and half a dozen other navigable streams crossing the narrow belt, cause the Douglas Spruce to be almost the first lumber tree to be reached, and no timber is more familiar to dealers than this under various names: "Oregon Pine," "Yellow and Red Fir," "Douglas Spruce," etc., the last being the most appropriate name.

The tree in favorable circumstances, as upon a high, cool plateau of the Sierra, becomes two to three hundred feet high, and four to seven feet, often eight to twelve feet in diameter. When standing alone on the edge of a forest it assumes a perfect pyramidal form—as do all the Spruces, and like them also in a dense forest it trims itself and becomes tall, straight, and slender.

The bark of the Douglas Spruce is quite variable though generally dark, but varying from dull black to reddish and even gray.

The wood is by no means uniform in appearance or quality. Two kinds are generally distinguishable, designated by the prevailing color: one being close-grained and yellowish, giving the timber the lumberman's name of "Yellow Fir;" the other coarse-grained and reddish, and called "Red Fir." As the tree is decidedly not a Fir, but a Spruce, it is desirable to always use the proper term of Spruce, and so get it substituted, in time, for the lumberman's erroneous name of Fir.

Experienced woodmen claim that they can distinguish the Yellow from the Red Douglas Spruce by the general appearance of the tree, and the characters of the limbs, bark, etc.; but others declare that only the ax and saw will certainly reveal the characters—and this seems the

more probable, if what they assert is true, *i. e.*, that both red and yellow wood may often be found in the same tree.

It may be stated just here, that the manufactured lumber certainly presents two well marked and differently colored kinds, whatever trouble the botanists may find in trying to account for it.

The external characters are these: "Yellow" Douglas Spruce is generally found nearest to the coast, and is a heavier bodied, longer limbed tree than the other, and it has spreading, or sweeping foliage; the bark is brownish or grayish, coarse, and deeply furrowed. "Red" Douglas Spruce is generally found farther inland, and is apt to be tall and slender, but little tapered upward, its bark brown, or even black, and nearly smooth, slightly furrowed; the lower limbs are descending, often with pendulous branchlets several feet long; the hue of the foliage, also, is a darker green.

The characters of the wood as usually observed are: "Yellow" Spruce has sap-wood of a faint, creamy tint, the heart-wood darker, generally a decided yellow, often a saffron tint; the grain may be coarse or fine, but the two tissues (summer and winter) are very different in texture, but easily worked when handled with care; also, the yellow sort may often be found in long lengths clear of knots. "Red" Spruce is usually decidedly reddish, a light cherry red; the annual layers, generally coarse and wide, are so evenly grained that in working it presents a hard, flinty surface; also, the Red Spruce is apt to be accompanied by knots, usually, however, firmly interwoven with the other layers, and so not seriously affecting the serviceability of the timber.

For many kinds of construction the Douglas Spruce is used in vast quantities. For spars and ship building it has scarcely a superior.

Squared timbers eighty to one hundred feet long may be seen daily sawed and carried out of the many factories on the Puget Sound directly aboard vessels bound to foreign and domestic ports. Piles, mining timbers, railway ties, flooring, stair lumber, weather-boarding—almost every sort of use is made of the Douglas Spruce, its exceeding variableness affording a wide choice in its application.

It is impossible to arrive at any reliable figures enumerating the amount of this lumber produced in the Northwest, for the reason that the Douglas Spruce and the Tide-land Spruce, as also a species of Fir, often growing together, are usually cut, manufactured, and marketed together.

The consumption or shipment from the San Francisco market alone is not far from two hundred million feet, board measure, annually; and of this the output for California lumber factories must be from twenty-five million to thirty million feet.

In the rich Redwood sections of Santa Cruz, Mendocino, Humboldt, and Del Norte Counties, the Redwood is principally sought, and the other trees are only worked, for the most part, because they happen to be in the way, and are utilized as so much profit from what would be otherwise wasted; but in the Oregon, Washington, and British Columbia regions the Douglas Spruce is primarily desired.

POTENCY OF THE DOUGLAS SPRUCE.

No tree of the Northwest is wider or more densely distributed than the Douglas Spruce. Found abundantly in British Columbia, it is

indigenous on all the cross ranges reaching to the western slopes of the Rocky Mountains, and is found on nearly all the ranges paralleling the coast, far into Mexico—the only considerable ranges omitted being those of the dry interior basin between the Sierra Nevada and the Wasatch Mountains. This great extension of habitat is very remarkable; also, it is found in apparent equal vigor and enormous dimensions alike near the sea level or near the alpine limits of forest vegetation, as at the altitude of ten thousand feet in the mountains of Colorado. In California some of the largest trees, eight to twelve feet in diameter, are found in the high, cool, western slopes of the Sierra Nevada at elevations of four thousand to eight thousand feet.*

Wherever any other trees are found flourishing best, no matter of what species, *there* the Douglas Spruce will be at its best also, as witness its enormous development in the noted groves of Big Trees in the Sierra, where it vies with them and the Sugar Pine in size. No other tree seems to have such pliability of constitution; any soil, any condition, any exposure almost, is welcome to this cosmopolitan tree, and this quality of adaptability to varied conditions has been wisely availed of by cultivators, for of late years the Douglas Spruce has been largely planted at home and abroad; especially is it used in reforesting denuded regions of Europe. Large quantities of seed are collected annually, and sent abroad, and nurseries of seedlings are found in nearly every province, while large areas of forest preserves have already been planted with Douglas Spruce.

Principal of the Old World countries intent upon benefiting themselves by the use of our trees is Germany, and especially the kingdom of Prussia. Last season Herr William Kessler, Chief Forester of Prussia, came to the United States via Mexico, and he especially examined our western forests, expressing himself as delighted with observations upon the qualities and habits of the Douglas Spruce—this arboreal product of the Northwest affording him the most material for the report to his Government, which followed his return.

Quite recently (April, 1890), a German writer, Dr. Heinrich Mayer, has published several articles in the "Garden and Forest" upon our Cone-bearers, notably one upon this tree, which in Germany is called "Douglasia." He writes at length about its desirable qualities and its cultivability. He declares that the Douglasia will become the Larch of the level and low lands of Germany. This is saying much in its praise where the Larch is as highly valued as in Germany.

The tree in cultivation maintains its disposition to vary greatly, and the doctor writes: "Where it is heaviest, it comes nearest to Larch, but when lightest it is the equal of any Fir, Spruce, or Pine."

Second only to the Germans are the French, Belgians, Austrians, Swiss, Italians, and English, in their appreciation and utilization of the Douglas Spruce, while large quantities of the seeds are exported yearly to Australia and New Zealand.

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* A specimen tree section of Douglas Spruce was sent by the writer to the Centennial Exposition at Philadelphia, from a tree cut near Webber Lake, Sierra County, California, at an elevation of seven thousand six hundred and twenty feet, that was two hundred and forty-five feet high, nine and one half feet in diameter, and five hundred and sixty-five years old.

Fir.
fica.

No. 13.—Fruit-bearing upper portion of a young tree near Lake Tahoe, California. A cross-section of a leaf, a pair of the winged seeds, and both sides of cone scales displayed. Photographed from a painting by Mrs. J. G. Lemmon.

THE MANY NAMES FOR THE DOUGLAS SPRUCE.

No other western tree has been so much tossed about by the botanists and given so many names. While all the pitch trees, now treated as the tribe ABIETINEÆ, were included in the genus *Pinus*, meager specimens of this tree had come into the possession of the English botanist, A. B. Lambert, Vice-President of the Linnæan Society, collected by the pioneer Mr. Menzies, while voyaging on the northwest coast with Captain Vancouver, in 1797. Professor Lambert briefly described the species in his great work, "The Genus Pinus," published 1803, under the name of "PINUS TAXIFOLIA, the Yew-leaved Fir." In a subsequent edition, 1837, he published a full description under the name "PINUS DOUGLASII, the Trident-bracted Fir" (adopting Mr. Sabine's manuscript name of *Douglasii*), and following the description with this interesting paragraph:

"The materials whence my former account of this species was derived were so imperfect, and the name I had applied being by no means a happy one, and the more especially as the Silver Fir has been called *Abies taxifolia*, I gladly adopt the name of *Pinus Douglasii* in honor of the indefatigable botanist to whom I am indebted for full specimens, from which I have been able to complete my descriptions and plates of the species."

In 1855 the French botanist Carrière, in "TRAITÉ CONIFERÆ," described anew the known species, and he took occasion to separate the Hemlock Spruces from *Abies* under the name of *Tsuga;* and also the form we call Douglas Spruce, in a recent edition, 1887, he put into a new genus, calling it *Pseudotsuga* (meaning "False Yew-tree"), unfortunately a difficult name to popularize, as it is also inappropriate, botanically considered.

Under the name of *Pseudotsuga Douglasii*, the species has been treated in most subsequent publications until very recently.

Lately, Prof. E. L. Greene, of the University of California, followed by several eminent botanists at the East, manifests a disposition to restore the observance of the early "orthodox" law in accordance with the "immense majority vote" of the International Botanical Congress assembled at Paris in 1867, to wit:

ART. 48. For the indication of the name or names of any group, it is necessary to quote the author who first published the name or combination of names in question.

Bearing directly upon the question of the proper name of this Spruce is:

ART. 59. Nobody is authorized to change a name [not even the author of it] because it is badly chosen, or disagreeable, or another is preferable, or for any other motive of little import.

"Publication," adds the venerable De Candolle, "is a fact which even the author cannot annul."

So despite the "unhappy" name of *taxifolia*, which Professor Lambert promptly changed to *Douglasii*, and the good reasons he gave therefor, it is held that an author cannot even change his own work after it is published, and so the earliest (1803) name of *taxifolia* (meaning "Yew-leaved," a term that does not distinguish our species because all the other Hemlock Spruces have yew-like leaves also) must be restored to this species.

This is doubly to be regretted, because to change the specific name

thus is to dissever the name of Douglas from immediate association with this species, and it will necessitate some difficulty in establishing his as the popular name. However, as the renowned explorer, David Douglas, had so much to do with obtaining full specimens and disseminating information concerning this as well as numbers of other trees of the Northwest, it is but proper and most fitting that the name of "Douglas Spruce," which has so long obtained precedence, should still be used as the popular name of this noble tree. The Germans, happily, though unscientifically, are helping us in this instance, by calling this Spruce "Douglasia," notwithstanding there is a genus of *Primulaceous* plants dedicated to Douglas under that name.

18. Pseudotsuga macrocarpa, Lemmon.

(*Pseudotsuga Douglasii* Var. *macrocarpa*, Engelmann.)

BIG-CONE FALSE SPRUCE.

[See Illustration No. 11.]

The Big-Cone False Spruce is found on portions of the San Bernardino and other limited ranges of Southern California. It is never so large a tree as the other species, and when mature, is less symmetrical. The limbs are apt to be few, long, and horizontal; the bark dark, thick, and deeply furrowed; the leaves are narrower, more inclined to be acute, and they are keeled by a mid-nerve on the under side; the cones, produced abundantly, are very large, cylindrical—five to eight inches long, and one and one half to two inches thick; the bracts one and one half inches long, and exserted one half to three fourths of an inch, are widest above, three eighths of an inch wide, erose on the margins, and divided above into two acute teeth, the oval-shaped mid-rib extending a half inch farther between them.

The scales are orbicular and convex, the exposed portion with a narrow, thin, crenulate, or wavy edge; seeds large, three to four lines long; wing elliptical, eight to ten lines long. (See illustration, Big-Cone Spruce, No. 11.)

This tree was first discovered by Lieutenant Ives, in his exploration of Southern California, in 1858, and it was named by Dr. Torrey, in his report of the botany of the expedition, as variety *macrocarpa* of *Abies Douglasii*. Later, Dr. George Vasey, Botanist of the Agricultural Department at Washington, in an article contributed to the "Gardener's Monthly," catalogued the tree as *Abies macrocarpa*, thus giving it specific rank; but all the writers who have since had occasion to treat of it, have regarded it merely as a variety of the Douglas False Spruce.

I have in these papers given this False Spruce the rank of a species, as *Pseudotsuga macrocarpa*, without hesitation, because I recognize in it elements that certainly point to such separation.

It must be borne in mind that the evidence of distinctness does not depend so much upon the number of characters, as upon their permanence.

Now, the characters of this Spruce are always uniform—no transition trees connect to the other species.

Again, the other species is both north and south of it, particularly north. If this big-cone development is a recent variation, what has pro-

duced it? If a southern climate, why are not the Arizona and Mexican trees still larger coned? If a dwarfed variety, why so prolific in fruit?*

Like the three species of True Cedar described, they resemble one another closely, yet they were evidently separated so long ago that they are now modified by environment, and become distinct lines of development. To unite them arbitrarily is, to say the least, unscientific.

ABIES, Link.

THE TRUE FIR.

The True Firs comprise a single but very large and interesting genus of Pitch Trees, distinguished from the rest by having lateral erect cones, with deciduous, equal-sized scales; and the leaves, falling, leave circular scars upon the branchlets.

The Firs are prominently distinguished from the Spruces, by having, in youth, their branches set in verticils, or whorls of three to nine, with the branchlets in two ranks and forming horizontal strata of foliage, in size diminishing regularly from bottom to summit of the tree, continuing most symmetrical objects in age, even, unless crowded in forests, when they become self-mutilated by dissevering the lower limbs.

The fruit (cone or bur) of the Fir differs from the Spruce, in that it is produced mostly upon the upper branches—rarely when the trees are heavily fruited on the middle ones, also—and the cones are erect upon the upper side of the short, thick branchlets; also, they are mostly cylindrical, and with woolly, close, equal sized scales. At maturity the scales fall away, leaving the axis or receptacle attached to the branchlet. The cone bracts, always conspicuous when the cone is young, in some species stop developing at an early age, while the cone scales grow larger, and soon completely conceal the bracts.† In other species the bracts continue to grow, and, at maturity, are seen protruding far out between the scales.

The leaves of the two genera—Fir and Spruce—agree in being solitary and produced in spirals around the branchlets, but the Fir leaves are more distinctly whitened on the under side (often on both sides) by many rows of white-mouthed stomata, or breathing pores, giving to these trees, anciently, the name of Silver Firs.

The male flowers of both genera are much alike, being spike-like, compound flowers, composed of numerous stamens borne on a short stipe or stalk arising from the numerous bud scales.

The wood of these two great families of trees differs greatly. The Spruce is mostly slow growing, strong, elastic, and durable, while that of the Fir grows rapidly, and is often brittle, soft—soon decaying. There are notable exceptions to these latter characters in our western Fir species, some of which are highly esteemed for their excellent manufacturing qualities.

The cones of all Firs are cylindrical, or nearly so, hence their fertile scales are uniform in size from end to end of the cone. They are

*When I first visited the headquarters of this Big-Cone False Spruce, in the San Bernardino Mountains, May, 1876, the cones of the preceding year's crop lay on the ground so abundantly that they were two or three deep under most of the trees—a degree of fecundity never observed in the *taxifolia* species.

† See short bract on single scale in illustration of California Red Fir.

always compactly and symmetrically arranged in nearly flat spirals directed to the right. The upper exposed portion of the scale is always wide in proportion to its length, and while growing is swelled outward by a smooth boss (umbo), when dried (as in herbarium specimens), so convexed as to appear swollen.

When removed from the cone axis, or receptacle, and freed from its two seeds, a scale reminds of a saddler's cutting knife or an Indian tomahawk without the handle.

The seeds are elongated, angular, and like the Hemlock Spruces, they bear resin vesicles on their surfaces; the kernel is oily, with a terebinthine taste. The seed wings are coextensive with the expansion of the scale, each wing covering one half of the scale, also covering the upper side of the seed, and lapping over a part of the lower side. In shape, they resemble a common nail hatchet, and they are firmly persistent to the seed.*

Like the Spruce and Pine families, the Firs are widely distributed over northern portions of both continents, and from the sea level to mountain summit. The most southern species on the eastern continent is on the Atlas Mountains of northern Africa, along with the Atlas Cedar described; the most southern Fir in America is found sparsely on the highest Cordilleras of Mexico.

19. Abies taxifolia, Desfontaine.

THE COMMON EUROPEAN FIR.

One of the Old World species must be described for the benefit of comparisons. The Common Fir of Europe, largely planted in parks and forest preserves, is indigenous on the higher Alps at elevations of two thousand to four thousand five hundred feet, and it forms dark green belts of color between the mountain fringes of lighter colored Norway Spruce above, and the parti-colored, deciduous-leaved Oaks and Ashes below; also, it extends farther south along the mountain ranges than does the Spruce, being found the entire length of the Apennines, and on the Carpathian Mountains south as far as the historic elevations of Greece.

This Common Fir is a lofty tree (for Europe), being eighty to one hundred feet high, and occasionally reaching four to five feet in diameter, with a straight, erect trunk, regularly furnished with whorls of branches in the usual manner. What is supposed to be a variety of the Common Fir was formerly plentiful on the Grecian mountains, including the sacred Mount Apollo, and upon the mighty and celebrated Mounts Parnassus and Olympus, where, in olden times, the people climbed up in vast numbers to consult the oracles, and where giants piled up rocks in hopes to scale heaven. On Mount Mænalaŭs a grove of Firs so protected the snow from melting that the ancients characterized the locality as the "Abode of Winter."

In poetical and historical references of early times, where the word "Pine" is used (in Greek *Pitys*), it is probable that some form of this Fir is meant, on account of its accessibility. Until about the year 1700,

* See winged seeds in illustrations of California White Fir, California Red Fir, and Yellow-fruited Fir.

Yellow-fruited Fir.

No. 14.—Bearing upper branch of a tree near Webber Lake, California. A cross-section of a leaf, cone bracts, a pair of the winged seeds, and the cone scales displayed. Photographed from a painting by Mrs. J. G. Lemmon.

the term *Pinus* was applied to all the pitch-bearing trees—a practice still allowed to poets, travelers, and unscientific writers.

As in the western continent, so in the eastern, often isolated ranges of mountains will possess their special species of Fir. From the Sierras of the Spanish Peninsula to the lofty masses of the Himalayas of India, thence to the sacred Fusi-Yama of Japan, the Firs are found clinging to their sides, all bearing a general resemblance, but each more or less specialized by the long separation of time and distance.

From the discussion given in early paragraphs of this report to the phenomena of the Glacial Epoch and Plant Dispersion, this specialization of the Fir family in Eurasia is just what is to be expected. As the sheet of ice receded northward at the close of the cold period the cold-loving plants endeavored to follow, but when obstacles of hills and mountains were encountered, the plants ascended them, keeping the while in congenial climate, *where their successors flourish to-day!* But if the mountains were not high enough, and winter's favoring conditions fled from them on the one hand, and the summer heat arose on the other and caught them on the last heights, withering their branchlets and sapping their vital powers year by year, from age to age, they slowly succumbed to fate, and thus many of the lines of development, which now we call species, became extinct.

20. Abies balsamea, Miller.

BALM OF GILEAD FIR.

This is the larger and more abundant of the two Firs indigenous to the eastern United States, and is found on the hills of Labrador and Canada and New England, west to the Great Bear Lake and the eastern base of the Rocky Mountains, south along the Alleghany Mountains to the peaks of Virginia.

It is a small tree, never exceeding seventy or eighty feet in height, by two feet in diameter. In alpine situations it is reduced to a prostrate shrub; in lower places it is at its best in damp woods and mountain swamps.

This tree, like most other species of Fir, is richly supplied with "balsam," an aromatic, liquid resin that is secreted in blisters or vesicles under the young bark of the stem and branches. By puncturing these blisters the "Balm of Gilead," so called, or balsam, is procured, becoming the celebrated Canada balsam, much used in the arts and in medicine.

There are several varieties of this eastern Fir in cultivation, with cones varying from three to four inches in length, and one to one and one half inches in thickness—in all respects not half as large as the Common Fir of Europe, and quite insignificant when compared with the mighty trees of the Northwest.

It is well worthy of cultivation, however, for parks and ornamental gardens.

21. ABIES RELIGIOSA, Schlect.

MEXICAN SACRED FIR.

This is a most beautiful species of Fir, inhabiting the highest peaks of Mexico and Guatemala.

In the cañons on the largest mountains it becomes a very symmetrical tree, one hundred and fifty to two hundred feet high and large in proportion. On the upper limit of vegetation, as on Popocatapetl, it is dwarfed to a flat-topped bush. The cones are small, three to five inches long, with the bracts long and exserted like its congeners, *Abies Fraseri* of the Eastern States and *Abies nobilis* of Oregon.

The Mexican Fir is much used in the ornamentation of parks and in the decoration of churches and cemeteries, by the native devotees of the warm south land, who regard this tree, holding out its waving branches from the lofty Cordilleras, much as did the ancient worshipers of the Cedar of Lebanon, in the valley of Palestine, as a benison of good; blessing by the fragrance of its foliage and the healing qualities of its balsam.

FIRS OF THE NORTHWEST.

CONSPECTUS OF THE GENUS.

§ 1. MEGACARPÆ.—Species with cones large; bark, red within; leaves short, scattered.

A. Leaves flat, grooved above, keeled below.

1. *Abies amabilis.*—Amabilis, or Lovely Fir.
2. *Abies nobilis.*—Noble, or Bracted Red Fir.

B. Leaves quadrangular, keeled above and below.

3. *Abies magnifica.*—Magnificent Red Fir.
   Var. (*a*) *Shastensis.*—Shasta Red Fir.
   Var. (*b*) *Xanthocarpa.*—Yellow-fruited Fir.

§ 2. MICROCARPÆ.—Species with smaller cones; bark, grayish within; leaves longer, mostly two ranked, flat, grooved above, keeled below.

A. Leaves twisted at base.

4. *Abies grandis.*—Great, or Oregon White Fir.
5. *Abies Lowiana.*—Low's, or California White Fir.
6. *Abies venusta.*—Beautiful, or Bristle-cone Fir.

B. Leaves not twisted.

7. *Abies concolor.*—New Mexican White Fir.
8. *Abies lasiocarpa.*—Downy Scaled, or Alpine Fir.

DISTRIBUTION OF THE GENUS ABIES, OR FIR, IN THE NORTHWEST.

1. AMABILIS.—Mountains of British Columbia, near Fraser River, southward to Mount Hood, Oregon.
2. NOBILIS.—Cascade Mountains, near Mount Hood, and a few trees on the opposite Coast Range peaks.
3. MAGNIFICA.—Siskiyou Mountains and Shasta, southward along the Sierra Nevada to Kern County, California.
   Variety SHASTENSIS—Near Mounts Shasta and Eddy.
   Variety XANTHOCARPA.—Near Lakes Tahoe and Webber.
4. GRANDIS.—Mountains of British Columbia, southward on both Coast and Cascade Ranges to Central California.
5. LOWIANA.—Siskiyou Mountains and Shasta, southward along Sierra and Coast Ranges to Southern California.
6. CONCOLOR.—Mountains of Utah, New Mexico, Arizona, and San Bernardino Mountains, California.
7. VENUSTA.—Local, Santa Lucia Mountains, California, in only a few short ravines.
8. LASIOCARPA.—Alpine on a few high peaks of Alaska, British Columbia, Washington, Oregon, Idaho, Montana, Wyoming, Utah, and Colorado; perhaps in California.

LARGE-CONED, RED-BARKED FIRS.

22. ABIES AMABILIS, Forbes.

THE AMABILIS, OR LOVELY FIR.

This species of Fir, though discovered sixty-five years ago, was not certainly known to exist until recently, the reports of early explorers having lost their credence with botanists, who came to the conclusion that the traditional "Amabilis" was a form of some other species, or else a mythical Fir formed by mixing specimens of two or more species.

David Douglas, the veteran botanical explorer of the Northwest, on his first trip up the Columbia River in 1825, discovered this very local species September seventh "on the top of a high mountain, south of the Grand Rapids of the Columbia River, after a laborious climb of fifteen hours."

With it he had the good fortune to find another new Fir. The first he named *Pinus* (the generic name then of all the pitch trees) *amabilis*, on account of its lovely appearance; the other he called *Pinus nobilis*, for apparent reason, being a most noble tree in aspect.

The two species, he declared in his report, "are the grandest trees of the tribe."

Returning to Fort Vancouver, he there met Dr. Scouler, another successful explorer of the Great West, and the two spent the night in relating experiences, "until the sun, rising over the noble stream, apprised them that another day had begun."

Douglas lost the greater part of his specimens in various mishaps of long explorations during the winter season in a rough country, but succeeded in preserving a few, which he carried home to England and deposited with his English friends. Soon after, he published these two species of Firs, with a third species collected earlier at the mouth of the Columbia (*Abies grandis*, "the Grand Fir"), in the "Companion to the Botanical Magazine," 1836, as *Pinus amabilis* and *P. nobilis*.

In the year 1838 Dr. Lindley published the *A. nobilis* and *A. grandis*, under the present generic name *Abies*, in the "Penny Cyclopedia," and by this early publication of the species under the present generic reference, Dr. Lindley becomes the namer of these two species.

Subsequently (1839), Forbes, in the "Pinetum Woburnense," published all three species, with illustrations, under the generic name of *Abies*, and because he was the first to so publish the Amabilis Fir, he becomes the namer of that lovely species, while the enterprising, toiling, learned Douglas, unfortunately, loses this added honor.*

Time passed, and many botanists visited the Northwest; Jeffrey, in 1856, again reporting the Amabilis Fir from the Fraser River region,

* It is unfortunate, and it seems unjust that the discoverer of an object in natural history, one who, like Douglas, has the energy and daring to explore, the intelligence to comprehend when he has an object in sight that is new to science, and moreover, the ability to describe and name it correctly, referring it to the proper genus in vogue at the time of publishing—I say it seems unjust that such a namer should subsequently lose the honors of discovery and of authorship, because, forsooth, another view of the relative importance of groups places the object in another category, and, therefore, another person, to wit: the one who so places it, becomes the author of the species. Such is the latest usage, however, based upon lately revived ancient laws of nomenclature; and, in the long run, it works less mischief than would a reverse rule, whereby pseudo-scientists could air their vanity by foisting upon us a host of unfounded terms at will.

but others did not see it. For several years authors catalogued the species, relying upon the statements of Douglas and Jeffrey; but, at length, faith in their statements died out, and botanists began ignoring the species.

In 1879, Dr. Engelmann, who was elaborating the ABIETINEÆ for the "Botany of California," boldly declared that there must have been some mixing of Douglas' and Jeffrey's specimens, and the Lovely Fir was therefore a myth—a fictitious species.

The next year, however, in 1880, the doctor, accompanied by Professor Sargent and Dr. Parry, made an extended exploration of the forests of the great Northwest, intent upon settling, once for all, several doubtful subjects that had all along marred our descriptive work; and they were very successful—after toiling as Douglas had done—finding that in every case the original explorers had told but the truth.

On Silver Mountain, near Fort Hope, Fraser River, at the elevation of four thousand to five thousand feet, they came in sight of a beautiful, unfamiliar Fir, which they at once recognized as the long lost "Amabilis"—the same that Douglas had first made known fifty-five years previously.

A few weeks afterward Professor Sargent ascended the very mountain where Douglas made his fifteen-hour climb, just south of the Cascades of the Columbia River, and there also was found the Amabilis Fir in all its pristine beauty, and not far distant the Noble Fir, as Douglas had portrayed it.

In 1885, and again in 1889, the writer and Mrs. Lemmon explored the same forest region between the Columbia River and the base of Mount Shasta, where grow these two wonderful firs—*amabilis* and *nobilis*; also near and below them is *Abies grandis*, and above, high on the timber line of Mount Hood, is a fourth species—the *Abies lasiocarpa*—this restricted region of a few miles in extent, containing more species of Fir than any other known area.

The Amabilis Fir is a magnificent tree one hundred and fifty to two hundred feet high, with a straight trunk two to four feet in thickness in favorable situations, retaining its limbs and forming a perfect cone of dark green foliage.

The bark of young trees less than one hundred years old, is thin and very light colored for a Fir, sometimes almost white on the outside (but reddish within); that of older trees is thicker—two to three inches—and reddish gray. The leaves are fragrant in a marked degree, even in herbarium specimens. On the sterile branches they are densely crowded—all about three fourths to one inch long; those on upright shoots appressed and notched at the apex; those on bearing shoots are acute, and upward turned. All the leaves are flat, or nearly so, furrowed above and keeled below, with a white band of about six rows of stomata each side of the prominent midrib. A cross-section of a leaf reveals two small resin canals close to the epidermis below, and near the sides.

The cones are dark purple until maturity, four to six inches long, half as thick, tapering slightly towards the apex. The bracts are short, and concealed by the close packed scales in regular sets of spirals, inclined right and left, after the manner of the entire genus.

The timber appears to possess the same light, hard, close-grained character of the other Red Firs, but it is so local, and found at such a high elevation as to be practically unknown to lumbermen.

No. 15. A small tree, 60 feet high, near Mount Whitney, Tulare County, California. Illustrating the symmetrical branching of the Fir family.

Quite extensive growths of Amabilis Fir are now known to exist on certain mountains of British Columbia; also, there are scattering trees on a few peaks of the coast mountains, and, as shown, on the Cascade Mountains, near Mount Hood. The southern limit being unknown, perhaps exploration might reveal it within the borders of California.

23. ABIES NOBILIS, Lindley.

NOBLE, OR BRACTED RED FIR.

Much of the history of the Noble Fir has been given in discussing the Amabilis Fir. It was one of the first True Firs discovered by that indefatigable explorer, David Douglas. After a fifteen-hour climb up the Cascade Mountains, south of the Grand Rapids of the Columbia River, and in the vicinity of Mount Hood, he first detected this magnificent tree, and noting its noble bearing and great size, was prompted to name it *Pinus nobilis* (all the pitch trees in his times, sixty-five years ago, being considered as in the genus of Pines, the section embracing the "Silver Firs" being called *Abies*). It happened that several botanists soon after (about 1837) raised the section *Abies* to the rank of a genus, and Lindley, in 1838, published this Noble Fir with others in the "Penny Cyclopedia" as a species of *Abies*, and so he became the author.

The Noble Fir is less frequently met with than the Amabilis, being found only on the Cascade Mountains, as stated, in a very limited area, extending southward along the Cascade Range to the Umpqua and Rogue River spurs; also, it is sparsely found on a few of the Oregon coast mountains, and doubtless it extends to high plateaus within the limits of California. Only extended and careful exploration will determine this point.

The Noble or Bracted Fir is a red-barked tree one hundred and fifty to two hundred and fifty feet in height, and becomes three to five feet in diameter. The bark is brownish outside, reddish within; the limbs in favorable situations are regularly verticillate and nearly horizontal; the leaves densely crowded on the upper side of the branchlets; those on the lower surface twisted at the base so as to bring them into the horizontal position; those on the upper more or less curved and erect, so that the branchlets resemble long, narrow, flat brushes, the leaves representing the bristles.

The leaves of this Fir are mostly flat, though often partly quadrangular, the flat ones furrowed above and with a rounded keel below.

The cones are somewhat variable, usually long, and perfectly cylindrical, six to nine inches long and three to four inches thick. The most peculiar and beautiful character of this wonderful tree is connected with the decorations of the cone, consequent upon the great length and abrupt, depending, deeply dentated, dark brown portion of the bracts that are exserted even at maturity for a distance of one half to three fourths of an inch beyond the cone scales, and clothing the entire cone, as with many spirals of exquisite, narrow fringes of scales. These bracts remind one of the scales of the sturgeon. They are purple until maturity, turning a bright, glossy brown, the long, attenuate midrib darker.

Until the rediscovery of the Noble Fir recently on the Cascade Mountains by Professor Sargent, and its perfect identification as the original

of Douglas, a form of Fir with extended bracts upon its cones, found abundantly in the vicinity of Mount Shasta (my *A. magnifica*, var. *Shastensis*), was taken for the decorated, Bracted Fir of Douglas' discovery, and so it was treated as late as 1880 in the "Botany of California" and other publications. Now, the Noble Fir is found to be quite different. Its dark green, usually flat and furrowed leaves crowded upon the branchlets, and its mostly long, purple cones with long, exserted, and deeply toothed bracts, well distinguish it from all forms of the next species, with which it has been confounded.

Dr. Maxwell T. Masters, editor of the "Gardener's Chronicle," London, England, has published an able article (1886) in which he argues that all the Red Firs are but forms of one extensive, polymorphous species, the Nobilis form being the first discovered, becoming the type; the southern trees of California, he suggests, are merely varieties.

Cogent as may be these views, there are quite a number of salient points of difference, and it will be found, for the purposes of classification and forestal considerations, that it is best to treat them as separate species—doubtless derived at no distant date, geologically considered, from one stock, but separating so long ago as to be now practically distinct.

Nuttall, who visited the northwest coast in 1834, gathered materials for describing and illustrating this species in his "North American Sylva" under the name of "Decorated Silver Fir."

"To me," he writes, "this species appears very evidently allied to *Abies Douglasii*" [now *Pseudotsuga taxifolia*], a conclusion to which it seems impossible that so profound an observer as Nuttall could have arrived with the knowledge he had of both trees. Almost the only point of resemblance is the long, exserted bracts decorating the cones; but the Douglas Spruce cones are pendent, with persistent scales.

The wood of the Noble, or Bracted Fir is light, hard, strong, rather close-grained, and compact, qualities that commend it to lumbermen; but it is found only at such high elevations and in such limited range, that it is practically unknown.

It should be largely cultivated, if only for its symmetrical branching habit, its dark green foliage, and its beautifully decorated cones.

24. Abies magnifica, Murray.

MAGNIFICENT, OR CALIFORNIA RED FIR.

[See Illustration No. 13.]

This great Red Fir is not only the largest tree of the family, but is one of the largest trees in California, world famous for large forest trees. It is found on the high plateaus and sheltered slopes of the Sierra Nevada Mountains, on both sides, nearly from end to end of this lofty chain.

Around the base of Shasta, forming a dense, dark forest miles in extent, and scattered less thickly over the neighboring mountains of Trinity, Scott, and Eddy, is found a form of this Fir, with long exserted cone bracts, at elevations of four thousand to eight thousand feet; the southern typical form, with short, inclosed bracts, is found higher, reaching ten thousand feet near Mount Whitney.

This beautiful "Queen of the Sierra" is most regular in youth, with its verticils of branches maintained in perfection until age, if favorably

situated, and becoming a noble tower of stratified foliage one hundred and fifty to three hundred feet high. The leaves are so short and close wrapped, the branchlets so numerous and regularly placed as pinna along the broad, almost contiguous sprays, that the light of day is but partially admitted; and the visitor to a Fir forest, in looking upward, gazes through veil after veil of airy, gauzy, reticulated sprays that give an impression of beauty and grace that transcends anything elsewhere seen in the vegetable world.

Travelers who have visited all the noted forests of the globe constantly aver that our California Fir forests combine more of symmetrical arrangement, lofty and majestic port, columnar architecture, and gauzy, tapestried canopy, than meets the eye in any other region, save, perhaps, certain tropical groves of tree ferns; but these are not on such a scale of magnificence as characterize a California Fir forest.

The trunks of this magnificent tree, if in the forest depths, are straight, free of limbs to a great height, and perfectly columnar.

The bark is grayish or brown on the outside, very deeply cracked or seamed into large, mostly longitudinal sections. When broken or cut with a sharp instrument the bark is found to be hard and of a deep, madder red color.*

Of course, the layers of bark correspond in number to those of the wood, but the outer layers are finely broken by the expansion of the tree and are weathered off, leaving only the interior, later ones still abundant enough on old trees to be very thick—four to six inches.

The wood is light, soft, quite strong, close-grained, with a satiny sheen, and for these qualities it is much used in various manufactures. Strangely for a Fir tree, it is quite durable in contact with the soil, hence it is desirable for bridge timber, sills, railway ties, sidewalks, etc.

The color of the wood is light red; the sap-wood, usually very thick, is somewhat darker colored.

This Fir has long been known to lumbermen for its excellence, but as its habitat is usually quite elevated, not much Red Fir lumber has been manufactured, though as the Redwood, Pine, Spruce, and Douglas Spruce give out in the most approachable parts of our forests, and the sawmills are moved inland, the Firs will be more and more utilized, but, of course, each species in a different degree, according to quality.

It is quite impossible to obtain reliable figures of the annual production of any given species of Fir, for the reason that so many kinds of timber in lumber yards are called by one name; or, *vice versa*, a half dozen names are given to one species of tree.

There is need of a careful examination of our forest growths, and a systematic naming of each, accompanied by plain descriptions, that all concerned may converse about them intelligently and be understood.

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* I sent to the Centennial Exhibition, at Philadelphia, a section from the trunk of one of these Magnifica Firs, growing near Webber Lake, Sierra County, California, that was eleven feet four inches in diameter, four hundred and thirty-five years old, and one hundred and seventy-eight feet high. It required the labor of two men an entire day to saw the tree down, using an eleven-foot saw, cutting away the bark on opposite sides for the play of the saw; and when it fell it brought down twenty-three other trees, with a succession of crashes that continued for fully five minutes. A cut was taken from the butt of the log two feet four inches long, turned down on end, split into halves, one of the parts split and redivided, until a wedge-shaped section, eighteen inches wide on the back, and extending to the heart, was secured. This was split across half way between heart and bark, the heart turned about and lapped against the bark, making a quadrangular block, which, when dressed down and planed on one side, made a specimen two feet long, five and one half feet wide, and fifteen inches thick, attracting much interest at the Exhibition.

As in the other Red Firs, the object of greatest beauty about them is the large and prominent cone standing upright on the uppermost limbs. They are so large—six to eight inches long by half as wide—and they sit up on the almost bare branches so prim and conspicuous that they are often taken for a flock of pigeons, or a solitary owl or hawk. Especially is the description complete in the case of the decorated cones of the northern trees, with their many spirals of feather-like bracts draping them from end to end. The cone scales of nearly all Firs are woolly pubescent externally, and are very regularly and closely arranged in many spirals around the axis, each scale with a slightly raised horizontal boss or swelling on the upper or exposed end while growing. When removed from the axis and freed from its two seeds, a scale reminds, in outline, of a saddler's cutting knife, or an Indian tomahawk without the handle. The scales of the Red Firs are over an inch broad at the widest part of the blade.

The bracts are broad, modified, leaf-like expansions on the back of each scale; are various, mostly narrow and shorter than the scales—so are inclosed; often they are long and exserted, also notched and terminated by the awl-like midrib.

The seeds of the Fir family are angular, elongated, covered above by the base of the wing, which also laps over and partially covers the lower side. The seeds of Firs, like those of the Hemlock Spruces, bear on their surfaces one or more resin vesicles, and the kernel is very oily, with a terebinthine flavor.

The wings are persistent, and always nearly coextensive with the expansion of the cone-scale, each wing covering one half of the under side of a scale therefore, large or small, wide or narrow, according to the size and shape of the scale. Red Fir seed-wings are usually bright purple, the White Fir often pale.

The leaves of the Fir are, considering the *magnifica*, peculiar, and distinguish the species from others with which it has been confounded. They are not flat and grooved above, as in most other species, but quadrangular, and keeled by a longitudinal line above and below. They are never *twisted* at base, but those on the lower side of branchlets curve outward, so as to bring the points of the leaves upward.

The leaves of the Fir family are usually whitened beneath by the presence, in abundance, of lines of stomata, or breathing pores. All the Old World Firs have such whitened leaves, giving the popular name of "Silver Fir" to the whole family, but the name is not always appropriate on this continent.

The columns of stamens forming the male flowers of this Red Fir are usually abundant on the terminal branchlets fringing the lower limbs of adult trees, and, at maturity, when ready to discharge the pollen in yellow clouds, are about half an inch long, and of a bright, madder red color—so that when the limbs of a Magnificent Fir are swayed by a mountain zephyr at this period, it appears as if the tree was enveloped in lurid flames.

The Magnifica Fir is quite variable in the one respect—that of the length of the cone bracts—and one of its forms was, for many years, confounded with the "Noble" or "Bracted Fir" of Douglas, on account of the conspicuousness of its bracts; but, as was shown in the discussion of that species, it is plainly distinguished from that Fir by its

ite Fir.

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No. 16.—Fruiting branch of an upper, bearing branch of a tree near Yosemite, California. A cross-section of leaf, cone scales, and the two winged seeds displayed. Photographed from a painting by Mrs. J. G. Lemmon.

lighter green and less crowded leaves, quadrangular and doubly keeled; and by its cylindrical cones, with scales normally inclosed.

Differences in the characters of the timber are observable, also; not enough to classify whole forests of timber separately, but variable enough to give a large choice of material to the manufacturer.

25. Variety Shastensis, Lemmon.

THE SHASTA RED FIR.

This variety forms a large, almost exclusive forest on the high plateau of lava thrown out by Shasta in former times. A few trees are scattered, also, over the high southern slopes of Mount Eddy, Scott and the Trinity peaks, at elevations of six thousand to eight thousand feet. The illustration of two standing Firs, which accompanies this report, was taken from a photograph of trees at Horse Camp, near the timber line of Shasta, before sunrise.

The peculiarity of this variety of Fir, aside from its locality, is connected entirely with the fact of its cone-bracts becoming long and protruded, a half to a full inch between the scales, rendering the large purple cones, thus decked out with tasseled fringes, a most beautiful object. This feature of the cone caused this tree to be considered as identical with Douglas' "Bracted Fir," described, and it was so classified as late as 1880, in "California Botany," but is now known to be clearly distinct.

The trees are very large and lofty, though not so immense and high headed as in the typical southern form, but they become, on the southern slopes of Shasta, a dark, gloomy assemblage of massive black trunks, colored on the north side from base to the limbs with bright yellow lichen, or tree moss, the lower limbs draped here and there with long, sweeping festoons of black, filmy lichen, giving a funereal aspect to the whole scene, scarce relieved by the twitter of a red squirrel, the long, wailing note of a woodpecker, or the occasional cry of a bald eagle.

Too elevated to be yet reached by the avarice of man, but little is known of the qualities of this Red Fir, but it is probably not unlike its southern relatives.

26. Variety xanthocarpa, Lemmon.

THE YELLOW-FRUITED RED FIR.

[See Illustration No. 14.]

In the high Sierras around Meadow Lake, Sierra County, California, is a variety of this California Red Fir that is strikingly different from the typical trees forming the greater part of the noble forest around and below it.

It is a smaller, less symmetrical tree than the typical, and it bears smaller cones, averaging four to five inches long, half as thick near the base, tapering slightly to the apex, of a yellowish color until maturity (suggesting the name from the Greek *xanthos*, yellow), the scales, seeds, and seed wings proportionately smaller.

The leaves are very short, not over a half inch on the most vigorous branches, and they are close wrapped on the outer-bearing limbs,

making the branchlets seem almost naked, giving a still more airy and gauzy effect to the foliage that was mentioned as so pleasing a feature in the canopies formed by the lofty heads of the typical form.

It is perhaps this form that has been called *lasiocarpa* by seedsmen abroad, but that must be a misnomer, as the above name was applied by Hooker in 1840, to a truly woolly scaled Fir collected by Douglas on the alpine heights of Mount Hood in 1825 (to be described in the proper place).

This variety is another of the practically unknown trees of the great Sierra forests, and suggests the possible riches that clothe the slopes and high plateaus of the great California cloud condenser—the Sierra Nevada Mountain Range.

SMALL-CONED, WHITE-BARKED FIRS.

27. ABIES GRANDIS, Lindley.

GRAND, OR OREGON WHITE FIR.

This, the first of the White Firs to be discussed, is indigenous over a large area of the Northwest from Vancouver Island down along the low, rich valleys of Washington and Oregon and the higher valleys and slopes of the Sierra to Yosemite.

It was the first new tree to confront the great explorer, Douglas, on Cape Disappointment (the heavily wooded point south of the mouth of the Columbia River), where his vessel touched the coast (April, 1825), after having been kept, by the severe winter weather, outside the bar for six weeks. Of the weather, he declares: "The hurricanes of North America are a thousand times worse than those of the noted Cape Horn."

At last, on the seventh of April, at four P. M., the ship came to anchor in Baker's Bay, just north of the mouth of the river, and "thus terminated my long and tedious voyage of eight months and fourteen days." But at once his circumstances change. "The night following, I reckon as among the happiest moments of my life." "The greater part of the country," he states, "as far as the eye could reach was covered with pines of various species."*

On stepping out of the boat he picked up *Rubus spectabilis* and *Gaultheria Shallon*, and the first tree he reached was a new one which, on account of its great size, he named *Pinus grandis*, though he did not report his discovery until five years later (1830).

In 1836 he published it under that name in the "Companion to the Botanical Magazine." Subsequently (1837) Dr. Lindley published it in the "Penny Cyclopedia" as *Abies grandis*, and this being the present reference, he thus becomes the author of the species.

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* The Conifers (all called Pines in his day), which gladdened the soul of Douglas a few days after on that promontory of Cape Disappointment, were anything but disappointing to the storm-tossed botanist. There were at least eight species, representing as many genera, as we now know them, all within the radius of his vision: *Pinus contorta*, growing on the drifting sand of the outer shore; *Tsuga Mertensiana* and *Picea Sitchensis* next in the moist, swampy slopes of the promontory; the great *Thuya gigantea*, forming the greater part of the brow of the promontory, with the monster Fir, *Abies grandis*, and the great False Spruce, which was thereafter to bear his name *Pseudotsuga taxifolia*, crowning the elevation, while in deepest shade by spring or stream shone the bright-leaved Alaska Cedar, *Chamæcyparis Nutkensis*, and the Western Yew, *Taxus brevifolia*.

The Grand Fir is the most abundant and has the widest dispersion of any of the White Firs, with headquarters in the rich, moist valleys of western Washington and Oregon, where it attains often a height of two hundred to two hundred and fifty feet, with a diameter of three to four feet. It is a very beautiful tree when young or in open situations, with its regular whorls of horizontal branches. In age in the dense forest it trims itself to a great height and presents a tall, slim, naked boll, straight as a line for two thirds or three fourths of its height.

The species is distinguished for its comparatively long, flat leaves, glossy green, and channeled above, whitened below, with two longitudinal stripes of stomata, or breathing pores, in several close rows each side of the prominent midrib. The leaves are an inch or two long, narrow, and notched at the apex; those on lower limbs mostly two-ranked, on the upper branches shorter and curved around the branchlets so as to point upward. The leaves that are two-ranked become so by a twist, half round at the base, which brings the blade horizontal and on a plane with the branchlet; the leaves on the lower side of the branchlet are always twice longer than the upper ones.

The cones are olive green until maturity, small, usually perfectly cylindrical, and truncate at both ends, two to four inches long, composed of slightly pubescent, thin, uniform, closely packed scales, about twice broader than high, about an inch wide; the small bract on the back of each obcordate or two-lobed, with a short pointed midrib. The seeds are small—about one quarter of an inch long—the wing three times longer, widest above, light purple; the two wings nearly covering the upper surface of the scale.

HISTORY OF THE GRANDIS FIR.

Much confusion has existed with reference to this interesting species of White Fir, some authors putting several forms, including *Abies concolor*, and even the long lost *amabilis* with it. Dr. Masters, editor of the "Gardener's Chronicle," London, in a recent article (May, 1889), clearly shows that it is a most distinct species, limited and described as above, but he places it as variety *Lowiana*, the form of White Fir found exclusively in California in great abundance, and which I consider truly distinct, as discussed in proper place.

The *grandis*, which, being particularly abundant in Oregon, may be called, for distinction, the Oregon White Fir, makes very light, soft, coarse-grained timber, not strong nor durable, but it is largely manufactured in Oregon for interior finish, for packing cases, and cooperage. In California the trees are generally neglected as nearly worthless, except for fuel, the soft quality of the lumber giving for it the sobriquet of "Pumpkin Pine."

The bark of this tree may be brown, or even quite black, but within it is of a grayish hue like the other species with which it is associated in descriptions.

28. Abies Lowiana, McNab.

(*Abies grandis* var. *Lowiana*, Masters.)

LOW'S, OR CALIFORNIA WHITE FIR.

[See Illustrations Nos. 15 and 16.]

This Fir is distributed somewhat plentifully over the State at middle elevations, from the southern slopes of the Siskiyou Mountains and the Shasta region, down along the Coast and Sierra Ranges to nearly the southern end of the State. Its headquarters are in the high Sierra, where it often attains a height of one hundred and fifty to two hundred feet, with a diameter of four to six feet.

The bark is thick and deeply checked on old trees, and whether brown or darker, according to situation, is always whitish within, suggesting the common name of White Fir. As it is found abundantly and almost exclusively in California, I suggest that it be called California White Fir.

In the Sierra this tree is usually associated with those species of Pines that affect an elevated locality, as the Sugar Pine, Mountain Pine, and the Tamarack Pine, and with the Magnificent Fir and the Sub-alpine Spruce described—the California Fir forming broad belts of dark green forest just below and apparently supporting the other species of Cone-bearers, uplifted on the sheltered slopes of the Sierra.

The California White Fir, or *Abies Lowiana*, is distinguished by having a rather rigid habit, the branches relatively shorter and stouter than those of *Abies grandis*. The young shoots are olive green, the buds ovoid, the leaves dark green above, whitened with stomata below (also with a few rows above), the leaves relatively very long—one and one half to two inches—nearly all of the same length, obtuse (not indented) at the apex, not usually two-ranked, except on lower branches, yet all are twisted half around at the base, which allows the light to reach through to the branchlets past the distorted leaves.

The cones are nearly cylindrical, or narrowly elliptical, two to three inches long, light green until maturity; the scales not so closely packed nor so uniform as in *grandis*. They are rounded above, slightly pubescent, twice wider than high, upheld by a peduncle one fourth of an inch long, which is abruptly curved outward, thus supporting, erect, the convex blade or expansion of the scale.

The small bract, or modified leaf on the back of each scale, is lanceolate and acuminate, one fourth of an inch long.

The seeds are triangular, elongated, covered above by the shining base of the wing, which, as in all Fir species, laps over half of the lower side. The wings are light purple, widest above, half covering the surface of the scale, and are firmly persistent. (See illustration No. 16.)

The *Lowiana*, or California White Fir, though really quite distinct as shown, has, until lately, been considered a component part of one polymorphic and widely dispersed species, *Abies concolor*. Dr. Masters, before cited, calls it variety *Lowiana* of *Abies grandis;* but the true, original *grandis*, however, is indigenous to more moist, northern regions nearer the coast, and it displays several distinctive structural characters. The *Lowiana* is, in fact, midway, both in locality and in characters, between the green-leaved and green, cylindrical-coned

Bristle-cone Fir.

Abies (bracteata) venusta.

No. 17.—Bearing upper branches of trees in the extremely local region of Santa Lucia Mountains, Monterey County, California. Cone axis, bracted scales, flowers, seeds, and leaves displayed.

grandis of the moist, northern forests, and the white-leaved and light green, elliptical-coned *concolor* of the southern, arid, interior regions.

This Fir forms a large part of our California forests in certain localities, notably at middle elevations in sheltered valleys of the Sierra. Where accessible, it is largely manufactured into lumber, and used for light interior finish, as for linings, sheathings, and lathing. It is especially prized for fruit boxes, cooperage, and for all dairy products, dealers averring that this White Fir imparts no flavor to the contents of box or firkin.

For ornamental purposes this tree is planted extensively, and it thrives readily in varied soils. With its ashy green foliage, in regular, horizontal whorls, surmounted, in the season, by light green, top-shaped cones, it is a most pleasing object in cultivation. No tree could be more safely recommended for use in reforestation, as it is very hardy.

The origin of the name of this species of Fir is with Gordon, who, in a supplement to his "Pinetum" (1862), described this species under the name *Picea Lowiana*, the specific name given in compliment to the Messrs. Low, of the Clapton Nursery, England, gentlemen who were instrumental in having this tree introduced to cultivation.

Of course, when the name of the genus was changed to *Abies*, the first botanist thereafter to refer this species to that genus (which McNab did in 1876) has the credit of naming it.

29. Abies lasiocarpa, Nuttall.

(*Abies sub-alpina*, Engelmann.)

DOWNY-CONE, OR SUB-ALPINE FIR.

There is a tall, slender Fir tree bearing brown, narrow, not distinctively hairy cones, found on the timber line of certain high peaks of the Northwest, about which there has been much confusion.

It was first seen by Douglas, during his second exploration of the Columbia River country in 1830, perhaps on the flanks of Mount Hood, where it is now known to be abundant. Jeffrey collected specimens of it in 1852 on the peaks near Fraser River, in British Columbia. It (or similar ones) have been discovered since by several persons on the alpine peaks of the northern Rocky Mountains, the Cascades, and perhaps the Sierra Nevada.

It was described under the name of *Abies sub-alpina*, in 1880, by Dr. Engelmann, who, though he discussed the description of it given by Murray, and before him by Hooker, yet he very singularly ignored their names for the species. Murray, in 1864, having named it *Abies bifolia*, and Hooker twenty-four years earlier, to wit: in 1840, having named it *Pinus* (*Abies*) *lasiocarpa*.

Ever since the profound study given our western *Coniferæ* and their systematic characterization by Dr. Engelmann, in 1880 to 1884, this species has been called by his name, *A. sub-alpina*. As late as 1886, Dr. Masters, who since the death of Dr. Engelmann in 1884, has taken up our western conifers, published it under that name, though he gave some new matter concerning its history.

His reason for leaving the species under Engelmann's name is given as follows: "But for the doubt attaching to Hooker's name, *lasiocarpa*,

Nuttall's name, *Abies lasiocarpa*, should have precedence, on the ground of priority, but under the circumstances it seems preferable to adopt Engelmann's designation." But now, only three years later, 1889, Dr. Masters publishes an able article, with illustrations, in the "Journal of Botany" for May, in which he clears up much of the confusion, and shows, at least, that the name is not *sub-alpina*. "The earliest history of the tree," writes Dr. Masters, "dates from 1840, when it was described by Sir William Hooker under the name of *Pinus* (*Abies*) *lasiocarpa*. At that period Sir William considered *Abies* to be but a sub-genus of *Pinus*, an opinion in which he followed the example of Linnæus, Lambert, and others, and which, after Hooker, was adopted by Parlatore and others. The maintenance of *Abies*, however, as a distinct genus from either *Pinus* or *Picea*," adds Dr. Masters, "seems imperative on the ground of convenience, and hardly less so for scientific reasons. In the great work, 'Genera Plantarum,' by Bentham and Hooker, the three groups are treated as separate genera."

Sir William Hooker stated that he received his specimens from Douglas, collected on his last journey to Northwestern America in 1830. Nuttall, in his "Sylva" in 1855, and again in 1857, described, or rather repeated, the description of Hooker, but happily for him, referred the species to *Abies* as a genus, thus: "*Abies lasiocarpa*," and the vernacular name he gave as "Downy-coned Fir," for "the cones were clothed with a dense, almost ferruginous down."

Andrew Murray, in 1864, studied the species, and coming to the conclusion that Douglas' specimen, preserved in the Kew Herbarium, was a mixture of at least two species, he erected another species upon specimens "forwarded by Dr. Lyall from the Galton Range of the Rocky Mountains," and called it *Abies bifolia*, on account of its having two forms of leaves.

Dr. Engelmann, in 1876, in the "American Naturalist," described the species from specimens collected on the peaks of Colorado under the name *Abies sub-alpina*, as stated, a name continued by Sargent in "Forest Trees of North America" in 1884, and also by all subsequent writers, until the appearance of Dr. Masters' last article cited. But Dr. Masters, while showing that Dr. Engelmann had no right to ignore the names of Murray and Hooker, leaves it to be understood that Hooker is the author of the name "*lasiocarpa*," which is true enough, but Hooker did not *fully* refer the species to the genus *Abies*, which Nuttall *did*, and was the first to do so; hence, under the rules, he becomes the namer of the species thus: *Abies lasiocarpa*, Nuttall.

Professor Sargent, in "Garden and Forest," October 16, 1889, alludes to the article by Dr. Masters and properly credits this species to Nuttall.

The writer of these pages has met with this curious, tall, slender Fir, with its brown, narrow cones, in several of its localities, and fine specimens were collected in 1889 on the timber line of Mount Rainier (or Tacoma) by John Muir, Rev. E. C. Smith, and C. V. Piper at an elevation of seven thousand six hundred feet. What appears to be this species may be seen from the California and Oregon Railway train, standing like lances on the steep spire of Black Butte, near Mount Shasta.

Doubtless the species in one of its forms is indigenous to some of the alpine peaks of California, as it is distributed widely and on peaks of similar latitude and altitude.

Specimens in the Lemmon Herbarium, from various sources, show green, obtuse leaves an inch long on sterile branches; paler, shorter, and acute on bearing ones, all with two very large resin ducts within the parenchyma or fundamental tissue of the leaf—not near the epidermis as in most Fir leaves.

The cones are small, narrowly elliptical, two to three inches long, the scales three fourths to one inch wide, and the same in height, the exposed portion covered densely with brown, short, resinous hairs—the hairs suggesting to Hooker the name *lasiocarpa*.

The scales have the abrupt outward curvature of the peduncle observed in *Abies Lowiana*, causing the scale to become nearly erect.

The bracts are very small, three to four lines long, obovate on a narrow peduncle, and with a stout terminating point.

The seeds are relatively small, with large, fan-shaped wings, each covering nearly half the scale.

It may be these three forms of an Alpine Fir, which agree in many particulars, are yet separated by characters which only fuller materials and closer observations will disclose; but from the descriptions here given alpine explorers cannot fail to recognize it, and by collecting full data any one may help to clear up the remaining doubts about the inhabitants of these lofty sentinel stations, and so advance the domain of science.

The specific name *lasiocarpa*, coined by Hooker from Greek *lasios* (hairy) and *karpos* (fruit), alludes to the distinctly pubescent character of the cones, the exposed portion of the scales being distinctly ferruginous-hairy, more so than in any other species.

30. Abies venusta, Sargent.

(*Abies bracteata*, Nuttall.)

BRISTLE-CONE FIR.

[See Illustration No. 17.]

This is the most beautiful of the many species of the Fir family, being extremely symmetrical in its whorls of foliage and unique in the graceful decoration of its numerous cones by means of long, bristle-like terminations to the cone bracts.

It is also the most local and limited of the family, being found only in four or five narrow cañons on the ocean side and near the highest peaks of the Santa Lucia Mountains, half way between Monterey and San Luis Obispo.

They are at maturity tall, slender, pyramidal trees, one hundred to one hundred and fifty feet high; the largest not more than two feet in diameter; leaves mostly in two ranks, by a twist at the base; large, one and one half to two inches long by one to one and one half lines wide; acute, with two broad, white stripes beneath; above they are pale, smooth, and channeled; cones oval to cylindric, three or four inches long by one half as thick; bracts cuneate; obcordate about the length of the rounded scales, terminating in linear, elongated, leaf-like midribs, one to one and one half inches long. (See illustration No. 17.)

This matchless Fir is another of those trophies that rewarded the

laborious explorations and keen scrutiny of the veteran explorer of the Northwest, David Douglas, who discovered this tree in March, 1831.

A few paragraphs concerning this event and the various names the tree has borne, cannot fail to interest the general reader.

Mr. Douglas had made a journey to Northwest America in 1825–26, and had explored the Columbia River region industriously, making many important discoveries, especially of Cone-bearers. No sooner had he arrived home and disposed of what specimens he had saved out of his numerous disasters, than he longed to return. Favored by the Horticultural Society of England he made a second journey in 1830, reaching the mouth of the Columbia River in October. In December he sailed southward, intent on exploring California, which, though a hot country, he was convinced possessed hosts of new trees on its mountains. He passed by the Golden Gate—no one at that date attaching any importance to the large bay within and the little hamlet of "Yerba Buena" on the peninsula—and arrived at Monterey, the capital of the territory, December 22, 1830. So jealous were the Mexican authorities that Douglas had to spend three months in negotiating for a permit to explore in the territory. The little he could move about, unobserved, was richly rewarded, however.

"Early as was my visit to the coast," he writes, "spring had already commenced. The first plant I took in my hand was *Ribes speciosum* (a native gooseberry), in full bloom. The same day I added to my new species *Nemophila insignis*, an humble but lovely plant, the harbinger of California spring, and forming a carpet, as it were, of the tenderest azure hue."

When his permit to explore had arrived, he set out eagerly and soon had traversed the region round about, reporting his observations in letters to friends at home. Of California he writes: "Well does it merit its name. The heat is intense and the dryness of the atmosphere invariable, not infrequently 29 degrees, which, if I mistake not, is not exceeded in Africa or Persia. In this fine country how I lament the want of such majestic rivers as the Columbia!" he exclaims.

From time to time he contrived to make excursions to the interior and into the mountains of the coast, until the end of April, when he undertook a journey to Santa Barbara, about May fifteenth.

During one of these excursions from Monterey into the mountains, Douglas had the good fortune to discover this secluded Bristle-cone Fir, which he announces thus to his learned friend Hooker: "I will now mention another new pine to you, *Pinus venusta*, which I discovered last March [1831], on the high mountains of California (you will begin to think that I manufacture Pines at pleasure). As my notes are not at hand [they were subsequently lost], I must describe from memory." Douglas proceeds to describe from memory, and he allowed his imagination to amplify his descriptions, too. Unfortunately, he had no opportunity to revise and correct his descriptions aided by his notes, as he lost his life soon after at the Sandwich Islands.

In published descriptions Douglas is reported as stating: "The *Pinus venusta* attains a great height, and is never seen at lower elevations than six thousand feet, latitude 36 degrees, where it is not uncommon. The entire bracts or appendages between the scales are exserted three to four and one half inches." He, also, is quoted as giving another locality for the species: "On the high mountains along the Columbia River."

No. 18.—California Coast Redwood (*Sequoia sempervirens*). Bearing branches with the two-ranked foliage, the cones, scales, and seeds displayed. Photographed by J. G. Lemmon.

It is readily seen that the readers of Douglas' letters have confused this species with the other Bracted Fir of the Northwest—*Abies nobilis*—both of his discovery.

In the numerous published descriptions of this lovely Fir, another pioneer explorer is always connected with its discovery, to wit: Dr. Thomas Coulter.

Dr. Coulter arrived in Monterey in November, 1831, from the south, having the season previous explored the central States of Mexico.

Douglas gave the doctor a warm welcome to California. "Since I commenced this letter," he writes to Hooker, "Dr. Coulter has arrived. He is a man eminently calculated to work, full of zeal, very amiable, and I hope may do much good to science. I do assure you from my heart it is a *terrible* pleasure to me to meet a really good man, and one with whom I can talk on plants."

They had often met before, and around the fitful campfire had passed many a night in botanical converse. Little did the two friends dream then that soon they would be forever separated, and that inadvertently many of the discoveries of Douglas in the vicinity of Monterey would be credited to Dr. Coulter. Coulter visited, also, the locality of the new Fir, procured good specimens, which, with other conifers, he carried home. David Don, describing them in the Linn. Trans., 1837, not only ignored Douglas' name of *Pinus venusta*, published a year previous, but gave the credit of discovery to Dr. Coulter, thus: "*Pinus bracteata*, discovered by Dr. Coulter on the Santa Lucia Mountains of California, at an elevation of six thousand feet," etc. Lambert, in 1842, quoted Don; and the following botanists—Antoine, Hooker, Endlicher, Walpers, Parlatore, McNab—all continue the name of *bracteata*.

Loudon in his "Arboretum" (1844) changed the genus to *Picea*, following the error of Linnæus in assigning the Silver Firs to that genus, and he was followed by Gordon (1875), and later by Lawson, Nelson, Fowler, etc., all publishing it thus: *Picea bracteata*.

Nuttall in his "Sylva," 1854 (reprinted in 1857), had come a little nearer to the right reference by publishing the species as *Abies bracteata*, followed later by Hartweg, Lindley, Carrière, Hoopes, Engelmann, and a score of other authors, down to present date.

But all these authors have not observed Article 57 of the laws of Botanical Nomenclature, previously prevailing and readopted by one hundred and fifty botanists at Paris in 1867, to wit:

"When a species * * * is moved into another genus * * * the specific name * * * is maintained," unless in violation of Article 62, which requires that it be changed if there is already in that genus a species so named. In violation of this rule, it has been the custom of certain modern authors in revising genera to give to the species names at will, which they think are more appropriate, or for other non-essential reasons, forgetting that it is not the aim of science to make names only. "Names are used by her to distinguish things," writes De Candolle. "If a name is sufficiently distinct from others, that is the essential point."

Article 45 lays down the law: "Nobody is authorized to change a name because it is badly chosen, or disagreeable, or another is preferable," etc.

It remained for Professor C. S. Sargent, editor of "Garden and Forest," in a late issue of the journal (December 16, 1889), to restore

Douglas' name (sufficiently published with his memoirs by Curtis, in "Companion to Botanical Magazine," 1836), and to make the full and proper reference thus: *Abies venusta;* and this fortunate scientist, under the rules, becomes the namer of this beautiful species, which must hereafter always be referred to as *Abies venusta*, Sargent.

And it happens, moreover, that Douglas' name of "*venusta*" is most appropriate for this Fir. It is derived from Venus, the goddess of love and beauty, and means comely, graceful, lovely, etc. Why it was ignored so long—fifty-three years—is simply unaccountable.

Sequestered in but a few high perches on the sides of steep cañons in the almost inaccessible Santa Lucia Mountains, it required strength, daring, and zeal to make the discovery of this beautiful Fir; and the same requirements have rendered its visitation since of rare occurrence.

Theodor Hartweg, a German botanist, was sent to Mexico by the London Horticultural Society in 1836. He collected in California in 1846 and 1847, making his headquarters at Monterey, where he made some very interesting discoveries, and, being a powerful man, he determined to secure seeds of the new Fir.

John Meyers, now an aged citizen of Monterey, related to the writer recently the prominent events in the prosecution of this work of Hartweg's—for Mr. Meyers accompanied the botanist.

He describes Hartweg as a tall, slim, but strong, good-looking man of dark complexion, large, observant eyes, and quiet yet attractive demeanor.

They started out with two *burros* and what other equipments they thought necessary, and after several days of terrible struggle and almost fatal hardships, they reached the trees and secured a "flour sack full of cones."

The seeds were sent to London, and when two years old, the few plants that were produced were sold for 25 guineas apiece, or about $130.

The next season, 1847, they planned a second trip with four *burros* and better additional equipments in every respect; but although they reached the grove and scanned every tree, not a cone was to be seen (the Firs were not fruiting that season), a fact which they might have previously ascertained with little trouble by examination of other species nearer at hand, but no one at that time had observed this habit of the Fir family skipping a year occasionally.

Hartweg was blamed by his employers for failing to forward seeds and accused of playing false to them, which embittered the sensitive man and he left their service.

G. R. Vasey, son of Dr. Geo. Vasey, Botanist of the Department of Agriculture at Washington, several years ago penetrated the mountains to the vicinity of these trees and succeeded in securing good botanical specimens, with which he enriched several institutions, including the Lemmon Herbarium.

In 1882 Mr. T. S. Brandigee (now of the California Academy of Sciences) and his assistants climbed up to their fastnesses and, cutting down a characteristic tree, secured for the Jessup Museum at New York a section, which, being wrapped for safety in a bullock's hide, was dragged over the steeps to the borders of civilization by two mules harnessed tandem and led by a native.

The description of this Fir concludes the discussion of the many species of trees belonging to the ABIETINEÆ, or distinctly pitch-bearing trees, forming the largest, most important, sub-order of the Cone-bearers.

CONIFERÆ—Continued.

Sub-order 2. CUPRESSACEÆ. (See Scheme VI.)

CYPRESSES AND THEIR ALLIES.

This is a large group of trees composed of three tribes, each with two sub-tribes comprising seven genera; represented in the great forest development of the Northwest by thirteen species, eleven of them in California.

This sub-order of Cone-bearers include the largest trees known, and the closely allied forms—their progenitors—were particularly abundant in past ages, coeval with the colossal animals of the period, the megalonyx, dinotherium, pterodactyl, etc.

Like these animals, they are undeveloped in some respects, large and coarse, but not compacted and refined, especially in their respiratory and reproductive organs.

In the Cypress-like trees (with one exception) the taxonomy, or arrangement of leaves, fruit, scales, and the like, is opposite or verticillate, not scattered and spiral as is the characteristic of higher organized plants.

The exception to the general character of low development in this sub-order is found in the first tribe, TAXODINEÆ, the Redwoods and their allies, in which the taxonomy or arrangement of the leaves and cone bracts is spiral, and for that reason it is placed as the first or leader of the three tribes in Scheme VI, between the True Cypresses and the Junipers, and as leading the entire sub-order.

Very abundant in past ages, there are but few species extant; the two Redwoods of California being chief, with the less prodigious Bald Cypress in the Eastern and Southern States, the beautiful *Glyptostrobus* in China, and the likewise solitary *Cryptomeria* in Japan, both commonly cultivated in California.

The Redwoods being the special product of California, and withal trees of surpassing beauty, dimensions, and utility, will come up for extended description later on.

31. TAXODIUM DISTICHUM, Richard.

BALD CYPRESS—SOUTHERN CYPRESS.

The Bald, or Southern Cypress of the Eastern States is one of the largest trees in America. Though not particularly tall—seldom exceeding one hundred and fifty feet—it often reaches ten to fourteen feet in diameter.

This grand tree is especially abundant in the deep, frequently overflowed swamps of the Southern States, from the everglades of Florida to the bayous of Texas. "We read more of the Bald, or Southern Cypress," wrote Wilson Flagg, "perhaps, than any other American tree; but what we read relates to some of its peculiarities, such as the protuberances, called knees, that grow up from the roots of perfect trees, and of which, in the economy of Nature, it is difficult to discover the use."

Michaux, in his "Sylva," discusses the so called knees at some length: "Commonly two to five feet in thickness, of a conical shape; they are always smooth on the surface, and covered with a reddish bark, like the roots, which they resemble, also, in the softness of the wood."

"They exhibit no signs of vegetation," he writes (by which we infer that they are not subject to adventitious budding), "and are always hollow within. No cause can be assigned for their existence, and they begin to appear when the trees are but twenty to twenty-five feet high." In the South, the extension of the habitat of this tree is said to exactly coincide with that of the noted Pine barrens, two thousand five hundred miles, from Delaware to the mouth of the Neuces, in Texas.

Humboldt mentions finding it in the ancient gardens of the Emperors of Mexico, which were planted long before the arrival of the Spaniards.

In swamps that are annually covered with overflows of water and mud from swollen rivers the tree attains its utmost development, the trees being twenty-five to forty feet in circuit above the conical base, which at the surface of the earth is always three or four times as large as the continued trunk, and is always hollow.

The foliage is open, light, and of a light green tint; each "leaf," as Michaux calls it, is four or five inches long and consists of two parallel rows of small leaflets upon a common stem. This tender condition of the young branchlets—very much resembling the compound leaf of certain plants—reminds, also, of the frond of certain ferns; and this character of the branchlets of many species of Gymnosperms indicates the connection otherwise observable between this great class and the lower, flowerless sub-kingdom of *Cryptogamia*.

In the autumn the leaves change from light green to a dull red (a feature of our Coast Redwood, also), and are shed soon after—the only species in the tribe that has deciduous leaves.

The cones are small, globular, about an inch thick, composed of about four pairs of opposite scales, which are cuneate-pyramidal, attached by the apex to the ligneous axis of the cone, and displaying a rhomboidal, exposed surface which is slightly raised in the center and marked horizontally by a line; seeds, two, at the base of each scale, compressed, wingless. Pyramidal and quite regular when young, the trees of the Southern Cypress in age become flat-topped and somewhat decrepit. The timber is largely used for a number of purposes, being very easily worked and durable.

It is highly prized for buildings in southern cities, and shingles made of it last forty or fifty years even in that alternately moist and dry climate.

It is the favorite canoe cedar of the south, boats being fashioned from a single trunk twenty or thirty feet long.

Seedlings were planted largely about Paris many years ago, particularly upon the ancient estates of Duhamel, sixty miles from Paris, in 1750, but they have not thrived as other worthless trees do. Michaux thought (but wherefore he does not state) that in less than two centuries the *Taxodium distichum* would disappear from the Southern States.

No. 19.—Bearing branch from a tree in the Tuolumne Grove. A cone cut longitudinally and a minute seed, also one of the scale-like leaves enlarged.

REDWOODS.

SEQUOIA.

[See Frontispiece and Illustrations Nos. 18 and 19.]

The great size and extreme beauty of the California Redwoods has been the theme of countless descriptions ever since Douglas wrote of them in 1831 from Monterey, to Hooker: "The great beauty of California vegetation is a species of *Taxodium*, which gives the mountains a most peculiar, I was going to say awful, appearance—something which tells us plainly that we are not in Europe. I have measured specimens," he continues, "which are two hundred and seventy feet long and thirty-two feet around at three feet from the ground. Some few I saw upwards of three hundred feet high, but none in which the thickness was greater than I have stated."

The discussion of the Redwoods is only intelligible in connection with paleobotany, or the study of fossil plants. It appears through the researches of geologists that this family of monsters was once very abundant, both in individuals and species, and that, fostered by warm temperature then prevailing (known to scientists as Miocene times), these monster trees extended, coeval with the monstrous animals of the period, to high northern regions, even as far north as the 75th degree of latitude—that is, 8½ degrees within the Arctic circle.

Over a score of distinct species are known to have existed—fourteen of them in the Tertiary period.

When the Pliocene age was ushered in, characterized by the cooling of the earth, ice caps formed at the poles and extended equatorwards on both continents, driving the animals and plants before them.

The mountain tops being soonest affected by the lowering of the temperature, the flora and fauna gradually left them and began descending towards their bases, where they arrived coincident with the arrival of similarly organized beings from the north, and all together journeyed, or rather fled, before the sheet of ice to the equatorial regions, where at that period almost Arctic rigor must have prevailed.

Such plants and animals as had died previous to the time of this great migration, left their imperishable parts in the alluvium to be compacted into the rock strata and preserved as historical records.

When the Glacial age began to relax its rigor and the earth gradually became warmed again, the sheets of ice melting at their lower edges, began the retreat towards polar regions; those north of the equator retreating from the middle of Europe, and those of the United States northward, followed by the plants and animals as before they had fled before the ice.

But the retreat was vastly different from the advance. It was accompanied by dispersions, segregations, isolations, and enormous destruction, more or less, of entire groups of organisms, owing to reversed conditions. The plants and animals on the retreat arrived at the bases of the mountains, range after range, along their course, and, as being equivalent to going northward, some of them ascended the mountains, leaving others to journey along the plains, and there, as summit after summit was reached in the long retreat of ages, the plants were overtaken by the rising heat or by other inimical conditions, and were seized and exterminated. Others met with seas or deserts which they could

not cross, and there, huddled on the borders, each fiercely fighting with the other for vantage ground, or crouching in lowly submission, all were blotted out of existence.

Of the once great family of Redwoods, all perished thus in Eurasia, and but two forms survive in America. One is lodged in a few cool, moist cañons of the California Coast Ranges, over a limited area; the other is stranded at a few high stations on the southern slope of the Sierra, still more limited, not exceeding in area a few thousand acres all told.

These two forms, generally regarded as belonging to one genus, that of *Sequoia*, are quite diverse in vegetative characters, especially in the foliage; the coast form, *Sequoia sempervirens*, having its principal linear, Yew-like leaves in two ranks; the Sierra form, *Sequoia gigantea*, having small, scaly, Cypress-like leaves in regular spirals.

These discrepancies led Dr. Lindley to regard them as types of separate genera, and the last discovered one (our "Big Tree"), he published (1853) in the London "Gardener's Chronicle," under the improper name of *Wellingtonia*, derived from England's greatest military chieftain, the Duke of Wellington.

As might be expected, this act was offensive to Americans, and a great tumult ensued. Attempts were made (as if it were possible) to substitute the name of Washington for Wellington. However, the French botanist, Decaisne, in 1854, and again in 1865, followed by Torrey, Gray, Newberry, Seeman, Veitch, and others, declared the characters were not sufficient for generic rank, and the *Wellingtonia gigantea* was quickly relegated to *Sequoia*, and here it has generally been classed to the present time. But some considerations resulting from the geological researches referred to, open the question, in the mind of the writer, for thoughtful consideration.

WELLINGTONIA OR SEQUOIA, WHICH?

It is important to note, in connection with the ancient records filed away ages ago in the archives of Nature's great storehouse, that the species of Redwood now found in California, though not identical with those of the Miocene period, whose remains are so abundant in the strata of Greenland and Alaska, yet the differences are only what should be expected from such extensive double migrations as have been described, and from the vicissitudes of the long and severe struggle they have waged to maintain existence.

Further (and here is the strong point), "The Miocene species," as Professor Le Conte has well said, "fall into two distinct groups—the Yew-leaved and the Cypress-leaved." "The present species," he adds, "are evidently direct descendants of the Miocene species, though, of course, somewhat modified."

Now, query: If the Miocene Redwoods, and there are about twenty-five species of them, readily *fall into two groups*, separated by important vegetative characters, as stated, is it not evident that distinct generic separation of these species was long ago accomplished; and are not genera—yes, and all higher distinctions as well—established in precisely that way?

It is admitted that besides the male flowers the carpological characters (those concerning the fruits) of the Redwoods are much alike; so they are in all the great orders of *Umbelliferæ*, *Compositæ*, *Labiatæ*, and

Gramminex, and it was necessary to sever these immense, cumbrous orders into genera upon slight characters. And certain groups of Conifers are so much alike that it is a matter of botanic history that the fathers of our science long hesitated to separate *Pinus* into half a dozen genera, and again to redivide *Picea*, *Abies*, *Thuya*, and *Cypress* into several genera each.

Andrew Murray, in 1859, supporting the validity of *Wellingtonia*, wrote: "There is nothing which I have learned with more certainty from my zoölogical studies than that, in determining what elements are to be considered of generic value, no one set of characters can be wholly relied upon. It is a just appreciation and balancing of the whole that leads the naturalist to a right conclusion."

Structurally considered, we know that man cannot be separated from the Simian apes; but mentally, how wide is the gap!

If I were to recognize *Wellingtonia* as a valid genus, I would be influenced principally by the underlying fact that two lines of development are plainly revealed in fossil vestiges covering a great many species. Surely it would be inconsistent to crowd all these species into one genus in order *not to admit* a genus, which it is assumed is as distinct from the other as *Tsuga* from *Picea*, *Libocedrus* from *Thuya*, or *Chamæcyparis* from *Cupressus*.

But the establishment of "Wellingtonia" outside of paleontological evidence, rests almost wholly upon the character of the leaves, which, it is claimed, are widely different. Let us compare them: The leaves of both species (whitened beneath with stomata when young), are spirally arranged, decurrent, narrow, rigid, acute, or acuminate, each with a single dorsal resin duct; those of the Sierra species (*gigantea*) are pale, mostly small, scaly, Cypress-like; on branchlets of mature trees they are appressed, the free portion deltoid acuminate, while on young trees and on vigorous branches of older ones they are linear, narrow, and spreading.

The principal leaves of the coast species (*sempervirens*) are bright green above, mostly spreading by a twist at the base into two ranks, mostly linear and about one half inch long by a line wide (Yew-like), but those on the main stems and the one inch long peduncles (and often the lower portion of each branchlet) are short, appressed, and scale-like, *i. e.*, Cypress-like.

Now *since some of the leaves of both species are precisely like the principal ones of the other*, the distinction, based upon the leaf characters, falls to the ground, and with it, "*Wellingtonia.*"

If other species existed beside the two curious remnants, the consensus of characters might show more divergence in fruit as well as foliage, and then it would be easy to recognize two generic lines of development—which I do not doubt existed—but, weighing the evidences in the two present species, the Scotch verdict must be rendered, "Not proven."

So, to the great relief of American botanists, *Sequoia* stands to-day without a rival on the face of the earth, whatever may have been the sovereignty of Giants in the Dead Past.

NOTE.—For the selection of the objectionable name of *Wellingtonia*, in violation of the laws of botanical nomenclature and of good taste, Dr. Lindley was alone responsible. But the deed was done, and duly published with descriptions. The *name* is irrevocably fixed *if the genus exists in Nature.* The naming of American genera for Washington, Monroe, or Clinton, though in a sense unwise, cannot offend the national pride of any

foreign country. *Jeffersonia* and *Fremontia* do not fall under the slightest condemnation, because President Jefferson and General Fremont were distinguished naturalists. The dedication of California genera to our prominent citizens, Stanford, Crocker, Redding, Hastings, Hollister, and the like, is justifiable on the ground that these gentlemen are distinguished patrons of science—especially promoting original botanical research on the Pacific Slope.

The bark of *Sequoia*, like that of *Thuya* and *Libocedrus*, is thick, strong, slightly shredding off in age; deeply furrowed longitudinally, almost uninterrupted from bottom to top; making a tree resemble a fluted column or pilasters around a turret.

The wood is very light, soft, often brittle, coarse-grained, but taking a fine polish, very beautiful for interior finish, often remarkably gnarled and wavy, hence highly prized for ornamentation. It is not easily set on fire, hence is prized for general building purposes; fire kindled against Redwood partitions have been known to die out without igniting the partitions.

Fire does not readily kill a tree of the coast species, adventitious sprouts often coming out of a burned trunk and continuing the life of the tree.

The wood is remarkably durable, exposed to weather or in contact with the earth. Fragments of ancient trees are now lying in the forests half buried by the gradual accumulations of centuries of falling leaves and other debris, and yet they are as sound as ever.

The color of the Redwood is a bright, clear red, resembling mahogany, darker in the Sierra species, and not quite so susceptible to polishing. The quantity manufactured on the coast annually is estimated at over four thousand millions of feet. It is derived from hundreds of factories by improved methods of lumbering that secure the greatest amount of logs in the shortest space of time, and their manufacture into lumber has called upon invention and capital to provide the most elaborate machinery, while the kinds and grades of lumber produced are legion, and the uses to which they are put are innumerable.

Always among the highest priced lumber, yet the demand is, as a rule, in excess of supply, and the generous forests would be doomed to speedy destruction were it not for the inaccessibility of certain portions of every region in which it is found, coupled with the rapidity of its growth and the hardihood of its constitution, enabling it to resist alike the ravages of the ax and of fire.

The fruit of the *Sequoia*, maturing the second season, is surprisingly small. We look for large cones from colossal trees, and are disappointed to find the cones of the coast species but little larger than a lady's thimble, and that of the Great Sequoia about the size of a hen's egg. They are firmly woody, oval, of about thirty-six nearly equal sized scales, which are spirally arranged in three coils, and divergent at right angles from the axis, thick and pyramidal, with a rhomboidal, rugose, umbilical apex, traversed by a raised line and with a short spur or bristle in the depression. The scales shrink a little, but do not change position after maturing the seed. The spirals are three in number, inclining left and right, about twelve scales in each spiral. (See illustration No. 19.)

The cone (and the wood in a minor degree) secretes a dark garnet or crimson substance, which, as the cone hardens while approaching maturity, is exuded, and it crumbles away, falling with the seeds. In the

No. 20.—Gigantic Red Cedar (*Thuya gigantea*). Lower portion of trunk with workmen illustrating method of felling large trees in the forests of the Northwest.

gigantea species the quantity of this garnet tannin is fully one third as great as the numerous seeds.

John Muir, while wintering in the Yosemite, experimented with this secretion, and found several uses for it, including its serviceableness in in the manufacture of ink.

The seeds are brownish, small, and very numerous, resembling parsnip seeds, five to eight to a scale, and one hundred and fifty to two hundred and twenty to a cone; elongated about two lines, but appearing orbicular on account of the broad, thick wing extending each side of it.

The leaves have been sufficiently described in discussing the generic characters. The male flowers are small, oblong, two to three lines long, the coast species much the larger, but not otherwise distinguishable.

A tree much in cultivation in California, and nearly related to the Redwoods, is *Cryptomeria Japonica*, or Japan Cedar; so close is the resemblance to a young Sequoia, that it is often mistaken for our "Big Tree," having the same general appearance, the swell of the trunk near the base, and finely divided branches; but the trees come to fruit bearing when young with large quantities of small, globose cones clothed with free, subulate scales, and the leaves are awl-shaped and succulent, like those of the Norfolk Island Pine described. This Japan Cedar and another monotypic Chinese genus, *Glyptostrobus*, cultivated in the Eastern States, are closely related to our Redwoods, and, like them, are remnants of large and, with the exception noted, extinct species.

ORIGIN OF THE NAME SEQUOIA.

"Botanists who have genera to publish," reads Article 48 of Laws of Nomenclature, "show judgment and taste by attending to certain rules," one of which is to give the etymology of each name.

In the case of *Sequoia*, the Austrian botanist, Stephan Ladislaus Endlicher, who published the genus in 1847, did not make any statement whatever of the origin of the name, leaving its meaning to be inferred. In an early number of Meehan's "Gardener's Monthly," a learned and careful writer—J. H. Lippincott—who, Meehan says, was acquainted with De Candolle, and perhaps with associates of Endlicher, stated that *Sequoia* was derived from "Sequoyah," the Indian name of George Guess, a half-breed Cherokee, who has the distinction of having invented a syllabic alphabet for his tribe.

Professor Whitney, in "Yosemite Guide Book," and others have quoted this explanation of the origin down to date.

Gordon, in his first edition of "Pinetum," 1858, writes of *Sequoia:* "Name not explained;" but subsequently, in the edition of 1875, he states: "Name probably from 'sequence,' separated, or following in order of succession, after *Taxodium*, from which Professor Endlicher separated it."

In 1877 Hooker and Gray made a journey to the Pacific Coast, and in conversation with them, I asked which was the true origin of *Sequoia?* Dr. Gray quickly replied that the report of its being derived from Sequoyah, the Cherokee, was doubtless an afterthought; that undoubtedly Endlicher derived his name from *sequi* or *sequor*, alluding to the well known fact that our Redwoods are the followers or remnants of several colossal extinct species. I received the explanation with joy, as in my estimation it added greatly to the importance and poetical significance

of the name, and soon after I published Dr. Gray's explanation in the "Pacific Rural Press."

Proposing to elaborate anew, in a popular way, the Cone-bearers of the Northwest, I recently directed letters of inquiry to several eminent authorities in the East and abroad, especially for the paleontological history of our trees, the origin of their names, etc. In response came some very interesting letters. First, one from Prof. Thomas Meehan, of Philadelphia, under date of June 8, 1890, asks: "Are you sure that Dr. Gray told you *that* about Sequoia? If you did not misunderstand him, it shows that fifteen years after Lippincott's article appeared in my journal Dr. Gray had changed his mind." "For myself," continues Meehan, "I would regard the 'sequence' origin as still more unlikely, for in what way could Endlicher construct, orthographically, *sequoia* out of either the Greek or Latin root of sequence?"

Sir Joseph D. Hooker writes me, under date of July 28, 1890: "My impression is very strong that Dr. Gray accepted the view of Sequoia being named in honor of the American who invented the alphabet for his tribe language, but I have searched in vain for any printed information; however, I have not yet looked through all his writings about the Big Trees."

A letter from Alfonse De Candolle, bearing the date Geneva, 22d June, 1890, states (being translated): "The supposed origin of *Sequoia*, from *Sequoyah*, or *Sequenal*, is entirely fanciful—'fantastique.'" Endlicher seems never to have said why he had taken this name. Koch, in his "Dendrologie," 1872, says: "The name *Sequoia* has its origin in California;" but he gave no proof of the assertion. "By the appearance of the name," concludes De Candolle, "it seems probable that the name originated from or was taken up from some native word, and written more or less correctly." So the name is still a myth—"fantastique"—and may be derived from some Californian Indian word, in the opinion of the veteran botanist and author of "Prodromus," De Candolle, who is eighty-four years of age, and was contemporary with Endlicher, so is enabled to know as much about the origin of the word as any one. Dr. Engelmann evidently believed in the origin of the name as derived from the Cherokee, Sequoyah, for in 1873 he published the following in a St. Louis, Missouri, journal:

SEQUOIA.

His resting place may be unknown, but his name and his memory live in the most magnificent vegetables of the continent. The mammoth trees of California have been named by English, as well as Americans, for their greatest men—Wellington and Washington—while the celebrated Viennese, Professor Endlicher, as eminent a botanist as he was linguist, had already in 1847 established a genus, which comprises the mammoth trees as well as the scarcely less magnificent Redwood of the California coast; and he named it *Sequoia*, in commemoration of the aboriginal linguist; and so, as long as botanical science exists, both these wonders of the Western World will perpetuate the name of the Cherokee Cadmus, George Guess.

Giving Meehan and Engelmann the benefit of the doubt, it becomes interesting to us Californians to know something of the "Cherokee Cadmus" and his work:

George Guess, or *Sequoyah*, was a Cherokee half breed, born about 1770 in the Cherokee part of Georgia, where he lived on a small farm and was known as an ingenious silversmith. In 1826 he invented a syllabic alphabet of the language of his nation, consisting of eighty-five characters, each representing a single word. He used the characters that he found in an English spelling book as far as they went, though he knew no language but his own. In 1828 a newspaper called the "Phœnix" was established, part of which was printed in Guess' alphabet, and it was used in printing a part of the New Testament. Guess was not a Christian, and is said to have regretted his invention when he heard that

it had been used for the latter purpose. He accompanied his tribe in their emigration beyond the Mississippi, and in 1842 went with other Indians to San Fernando, in northern Mexico, where he died August, 1843.—*Am. Cyclopedia.*

Personally we wish there were no clouds obscuring *Sequoia*, the beautiful, unique name of our pair of monster, picturesque rear guards of that long past procession of Giants of the Vegetable Kingdom; but whether derived from Sequoyah, Sequor, or a Californian Indian word, as Karl Koch and De Candolle in turn suggest, we will be consoled by the last closing words of De Candolle, philosophical, terse, and clearly restating the scientific requisites of a good name. "After all," he writes, "it matters little; a name is a name. The essential things are: first, that it be the expression of a natural genus; second, that it has not been employed before; and third, that the genus had not previously received another name."

32. Sequoia sempervirens, Endlicher.

COAST REDWOOD.

[See Illustration No. 18.]

The wonderful Redwood of the California coast is too well known to need description. It is almost impossible to enumerate the uses to which it is devoted now that the Redwood has become so popular at the East. No modern house is well finished without more or less of natural dressed, unpainted curly or bird's-eye Redwood wainscotings, ceilings, panels, mantels, or other kinds of decorations.

The discussion of the quantity of the Redwood products, its value and uses, together with the ingenious means employed in procuring it, are outside of the province of the botanist, and it will be only necessary for me to give a few figures leading to other considerations we may be profited in discussing.

The lumber resources aggregrated in the Redwood forests are unquestionably more important on account of their value and accessibility than that of all the rest of the rich California forests combined.

From a consumption of Redwood lumber in the market of San Francisco alone, of ten millions of feet in 1860, an increase was noted to eighty-seven millions in 1870, and one hundred and twelve millions in 1875, falling off to eighty millions again in 1880, but vastly increasing to one hundred and fifteen millions in 1885, and perhaps one hundred and forty millions of feet for the present year, 1890.

The price ranges from $16 per thousand for pickets, and for rough dunnage at $20, up to dressed and surfaced lumber at $25 to $55 per thousand feet. Especial preparations of bird's-eye, or curled, or wavy Redwood, with their bright colors, worked into panels, veneering, furniture, etc., sell at fancy prices equivalent to $100 per thousand.

So great is its value, and accessible its locality, that it is apprehended that the supply will be exhausted, practically, at an early day, estimated at about fifty years.

The Redwood belt, so called, is rather a chain or congeries of groves of various sizes, stretched along the seacoast, coextensive with the metamorphic sandstone, from the southern border of Monterey County to near the Oregon line; no trees at a great distance from the ocean, or at high, cold altitudes.

The "Golden Gate," severing the Coast Range of mountains, and certain configurations of the range between Mendocino and Humboldt Counties, divide the chain into three principal unequal portions, the lowest one being the smallest. The largest body, and the largest trees, are found in the northern portion, individual specimens of mammoth size being aggregated in several slightly detached valleys and low bottom lands along the Eel River and its tributaries. Tall, clear shafts, uniform in size, healthy in appearance, and really very young in age, are standing in these forests so closely that their well developed foliage excludes the sun's rays except when near the zenith. These trees occupy the ground exclusively, and with the entire absence of stumps, fallen logs, as well as of young trees, they give a suggestion of a forest primeval—not derived from progenitors nor promising posterity.

However, there is not wanting evidence that forests have flourished and passed away, and been succeeded by other growths on this coast, age after age. Logs of Redwood have been met with in excavating tunnels, or exposed by river freshets that were buried from two hundred to three hundred feet under the present alluvium, and another fact of great importance is connected with this, to wit: the specimens so exposed are found to be in an excellent state of preservation, attesting the almost unexampled durability of this wood.

In this connection it should be stated that the Redwood timber is but little subject to shrinking and warping when exposed to the weather, and, next to chestnut, it is the least liable to take fire from contact with flames—a quality not recommending it for kindling wood, but especially desirable for building purposes. Fires kindled against Redwood partitions have been known to expire without igniting the partitions.

Whatever the statement to the contrary, only a few localities reveal Redwood seedling trees growing spontaneously, the principal increase or survival of Redwood groves being by suckers or sprouts.

Where the trees have been removed, either by fire in the centuries long past, or by the ax and saw of the white man, circles of trees show where the parent stood in the midst.

This power of increasing, by adventitious budding or suckering, is almost peculiar to this species among the Cone-bearers, and not at all characteristic of *Sequoia gigantea*. This feature is often quoted by thoughtless writers as evidence that this species of Redwood is—as its specific name implies—everlasting, but such inference is unwarrantable. No forest is ever maintained by such means outside of the tropics. Seedlings which admit of previous seed dispersions over wide areas only, can naturally reforest temperate regions.

This wonderful tree, second only to its gigantic brother in the Sierra, often attains a height of two hundred and fifty to three hundred feet, and a diameter of eight to twenty-two feet. The age of some evident patriarchs among them is doubtless very great, but is usually much exaggerated. Well authenticated countings of layers have given for robust, growing giants one thousand two hundred to one thousand five hundred years; and, certain relics of a practically former generation are, perhaps, twice as old.

The cones of the *Sequoia sempervirens* are very small, oval, three fourths to an inch long, composed of eighteen to twenty-one obpyramidal scales in three spirals. Seeds small, flat winged all around like a parsnip seed; brown, three to five to each scale. Leaves of two kinds, the prin-

Gigantic Red Cedar.

No. 21.—Bearing branches from trees near Tacoma, Washington. A twiglet with its scale-like leaves, a cone scale, and one of the winged seeds displayed.

cipal ones on the internodes of the branchlets, in two ranks, by a twist at base, linear, about one half inch long, the middle ones longest, all acute or mucronate, flat, keeled below by a prominent midrib, with a stripe of stomata on each side, white when young, the leaves in age often bronzed or browned; the other leaves found on the cone stems and main shoots small, short, scale-like or deltoid two to three lines long.

The presence of these small, cypress-like leaves, similar to those of the *Sequoia gigantea*, forbid the separation of the Redwoods into two genera, as has been proposed.

The male flowers are larger than those of the other species, ovate, two to three lines long, of few scale-like stamens with peltate connective, and four to six double-celled anthers under each scale.

33. Sequoia gigantea, Decaisne.

BIG TREE—GIANT SEQUOIA.

[See Frontispiece and No. 19.]

The Big Trees of California have been the amazement of every observer and the theme of thousands of descriptions since their discovery, therefore only brief mention of their most salient features need be given here, in addition to those presented in the discussion of the genus *Sequoia*.

When the great explorer, Douglas, first reached the locality in southern Oregon of the Sugar Pine, only the seeds of which he had seen two years before, he found himself in the midst of trunks, standing and prostrate, whose enormity so affected him that he feared to describe them to his friends, lest he should be discredited. "New and rare things," he writes to Dr. Hooker, "seldom fail to make strong impressions, and are, therefore, frequently overrated." So he trusts to nothing short of careful measurements, by which he learns that one of the prostrate trees was over fifty-seven feet in circuit, and two hundred and forty-five feet in length. "These princely trees," he cannot refrain from exclaiming, "are unquestionably the most splendid specimens of American vegetation!"

Little did the awe-struck traveler imagine that there could be a larger tree in the Western World, much less that in the very range of mountains three hundred miles south of his position the Sierra Nevada held on its swelling bosom a monster sylvan product nearly twice as far in circuit and four times as large—a tree so secluded that its eyrie was not detected by hunter or naturalist until fifteen years later, 1852, long after a large population had thronged the California mountains in search of gold. And when it was discovered, as Douglas had moralized in the forests of Oregon, visitor after visitor was discredited, until almost a convention of naturalists had seen the tree and given in their unanimous testimony. But it was long before pardonable exaggeration and loose, inaccurate guesswork were eliminated from descriptions.

Andrew Murray, writing in 1859 a monograph on California trees, states (getting his information from his brother): "One of these trees is actually four hundred and fifty feet high and one hundred and sixteen feet in circumference."

Lord Richard Grosvenor, in the "Gardener's Chronicle," 1870, makes

a similar statement, adding: "It is taller than St. Peter's, and little short of the highest pyramid."

When the American Horticultural Society visited the Redwood forest near Guerneville, two years ago (1888), a citizen of the place mounted upon a stump and made a flowery speech, in which he stated that the stump he stood upon was doubtless three thousand or four thousand years old, long antedating the birth of Moses!

As a matter of fact, the Big Trees, in age, unlike the coast Redwood, are not slim, tall trees, like a Poplar or Australian Gum tree, but are usually thick, and nearly columnar to a great height, where they suddenly divide into large branches, the foliage forming a rounded head.

And the present generation are mostly vigorous, fast-growing saplings, as proved by counting their rings, the oldest of them between one thousand two hundred and one thousand five hundred years old.

Fallen trees and stumps of a former generation, however, were very aged; they often show thin layers of wood, thirty to thirty-five to the inch, indicating trees probably two thousand five hundred to three thousand years old.

Forest fires occurring at a late period seem to have played havoc with these old patriarchs. There is one authentic living relic of that ancient race—Old Sequoia—in the Tuolumne Grove. A splinter of his trunk escaping the conflagration bears a green limb covered with bright foliage. This splinter is about one hundred and seventy-five feet high and forty feet wide at base, and with other remnants of the old tree, measure one hundred and twenty-one feet around a few inches above the base. A section of the splinter shows twenty-five or thirty layers to the inch and indicates an age of about two thousand five hundred years. Doubtless the height to which a tree may ascend is governed in part by the depth and steepness of the ravine it inhabits, forming a protection against the terrific storms of winter. Careful exploration at any time may reveal somewhere in the numerous cañons, trees overtopping anything reported of the Eucalyptus trees of Australia, whose slim spires, we are told, in a few instances, are slightly above four hundred feet.

The Grizzly Giant, in the Mariposa Grove, is perhaps a survivor of the old forest, as he is decrepit, and bears many evidences of extreme age.*

The Big Trees do not form a continuous belt of forest, nor are they exclusive. In the several groves they are accompanied by other trees that would be enormous elsewhere. There must be conditions in those regions that favor immense development, for Sugar Pines and Douglas

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*In a late able "Study of the Giant Trees," by Prof. C. B. Bradley, of the State University, he advances the theory that these great trees are self-limited in size and age by their very wealth of possessions. No sickliness or stunted appearance is ever seen in a *Sequoia* grove; no parasite or fungus attacks them.

"The *Sequoia*," he concludes, "has an astonishing exemption from disease, and this exemption, taken in connection with its sturdy build, gives it unusual immunity from accident of storm and flood; that the resources stored up in its mighty trunk enable it to repair damages which would be directly fatal to most other trees; that its thick, non-resinous bark gives it considerable defense against light forest fires, while the elevation of its top keeps that from being scorched; that the effects of fiercer fires, even in seasons of drought, are not immediately fatal, though they tend to become so eventually; that, after all, it is the tree's own weight—its overgrown wealth—which drags it down to destruction at last."

And so these young, vigorous, full habited, sound hearted giants are the only examples of suicides in the great class of exogens, or outside growers. Tempted by the favorable conditions and the bountiful food of a California forest preserve, they assimilate too much pabulum, become overweighted, and are capsized—tumbling to ruin in mid career, "with all their blushing honors thick upon them."

Spruce are met with ten to fourteen feet in diameter, while Firs and Post Cedars are scarcely less prodigious.

The groves are but few in number (about twenty-five), the principal and best known ones being Calaveras, South Grove, Tuolumne, Merced, Mariposa, Fresno, Kings River, and Kaweah. The southernmost ones are quite extensive forests of one thousand to three thousand acres, and somewhat scattered over ridges and valleys—separated only by deep cañons—for sixty miles, with a breadth of only five or six miles. The largest groves are southward, in Tulare County.

The altitude at which the Big Trees flourish, is, of course, a question of latitude also. In the Calaveras Grove they occur at about four thousand feet altitude; the Mariposa Grove is six thousand, and the Tulare Groves are over eight thousand feet altitude.

That people on horseback have rode for eighty odd feet through the body of the Father of the Forest; that a stump, with a pavilion over it, accommodates parties of thirty to forty dancers, musicians, and spectators; that trees have been pierced with tunnels for the passage of stages, with outside passengers; that hundreds of trees have been measured that are over ninety feet in circuit at the base; that the observer can verify these figures at will by pacing across their shadows; that the old ones were very aged, and that the present crop is comparatively young, are all well corroborated facts.

SATISFYING CONCLUSIONS.

Let India, with her Banyan tree—which, by the way, is a mass of trunks, not a single one—take the palm for growth of four thousand years, and the African Baobab date still further back, possibly, with its base of matchless circuit, but with a shaft only seventy to eighty feet high; let Palestine pride herself upon her Cedars, growing since the time of Moses, with layers so fine that it is necessary to use a lens to distinguish them; let Australia boast of her tall Eucalyptus trees: all these trees of the Old World, almost without exception, are slow growing, stunted, gnarled, decrepit, unsightly old relics, only interesting because of their great age.

Now all observers admit that the California Big Trees, with their vast, straight columns, limbless for two hundred to three hundred feet, and their immense, shapely crowns of finely divided evergreen foliage, are the most symmetrical in form, magnificent in appearance, and actually the largest in dimensions of any trees yet known in all the world.

And they are but young, vigorous saplings yet, only one thousand two hundred to one thousand five hundred years old! Ages hence, full grown trees may be seen here—if they escape the fire fiend—that shall attain an unparalleled age and size—

> "For still the new transcends the old,
> In deeds and objects manifold."

How came these trees there in such limited numbers and at such particular stations?

These questions are too profound for solution with our present knowledge. We only know the immediate causes that led to their lodgment on the southern slopes of the southern Sierra, and these causes are con-

nected with the great glacial phenomena briefly alluded to in early paragraphs of this report.

The fossil remains of other species show that the family was once abundant in the extreme arctic regions of both continents. The climate of those regions must have been very warm. When the earth gradually became colder, ice formed at the poles and extended towards the equator, driving plants and animals before it. The ice caps are known to have reached middle Europe and middle United States, and the Redwoods then, from being arctic plants, *were tropical ones*. But not as we now take those terms: they were only tropical *in position*, the characters and requisites, no doubt, the same as now.

Upon the cessation of the cold period and the gradual return of warmth, the ice cap melted at the edge and retreated towards its present home in the arctic regions, followed by the organic world.

Encountering the cross ranges of mountains, some of the species separated from the rest and ascended the heights; and most of these seceders were there overtaken, seized, and exterminated by the rising heat.

Here and there a line of development suited to the present equable temperature became acclimated to its surroundings, or, reversing the terms, the environment proved suitable to certain lines of development; and so we find plants buried in dismal swamps, thronging on broad plains, clinging to mountain slopes, or stranded on lofty peaks—anywhere, everywhere, just where they can best wage the incessant battle of life.

And from all indications the climatic conditions found at particular spots on particular slopes of the southern Sierra are most favorable for the development of colossal vegetation, including the Big Trees.

No vestiges indicate that the line of occupation has advanced since the present epoch was ushered in; and here is an added proof of the great length of these geologic ages. Inferentially, if the earth should ever become warmer, but by a few degrees only, the line would advance towards the summit of the Sierra, or the conditions be so changed at present levels as to extinguish these wonderful remnants of what is practically a past prodigious family.

There is one fortunate and, for Americans, very encouraging circumstance connected with the name *Sequoia gigantea*. It is readily taken up by the public and made as familiar as a household word. The drivers of the Yosemite stages, the citizens living in the vicinity of the groves, even to the children, speak the name glibly, and the lumbermen have adopted it. Travelers and visitors usually at once acquire the name, and our legal documents, alluding to the *Sequoia* Parks, all employ the proper name for our Redwoods.

The Governor of California, addressing an appeal recently to the Secretary of the Department of the Interior, begs to have spared from sale and destruction the *Sequoia gigantea;* and Secretary Noble, in his reply, twice uses the same proper and beautiful name, declaring that "late decisions of the department are most positive and energetic in defense of the *Sequoia gigantea.*"

Libocedrus decurrens, Torr.

No. 22.—A small tree near Sisson, California, 70 feet high. Illustrating the pyramidal form of the Incense Cedar.

Sub-Tribe 2. CUPRESSINEÆ.

TRUE CYPRESSES AND THEIR NEAREST ALLIES.

This sub-tribe of trees include a large number of genera and species of slow-growing Cone-bearers, most of them in the Old World and Australia, with four genera in the United States, comprising ten species, six of them in California.

The characters common to them all (beside slow growing) are: leaves very small, scale-like; cones small, oblong, or globose; the scales valvate or peltate; the taxonomy, *i. e.*, the arrangement of all of the organs, leaves, scales, etc., is verticillate, in pairs, or rarely in triplets; and four-ranked, rarely three-ranked.

They comprise, in America, two pairs of closely allied genera:

First Pair—American Cedars, with cones oblong and scales flat, convex, or thickened; branchlets flat with dimorphous, decurrent leaves:

1. *Thuya*—Fertile scales, six; unequal, thin.
2. *Libocedrus*—Fertile scales, two; equal, thick.

Second Pair—True Cypresses, with cones globular, and scales pyramidal and peltate.

3. *Chamæcyparis*—Branchlets and leaves two-ranked; cones maturing in one year; seeds winged.
4. *Cupressus*—Branchlets and leaves *not* two-ranked; cones maturing in two years; seeds wingless.

SLOW GROWTH OF THE CYPRESSES.

Michaux says of the Cypress: "The concentric rings are more compressed near the center, an arrangement that is contrary to that observed in the Oak, Maple, Ash," etc.—a statement which is somewhat unscientific, since the annual layers are not "compressed" near the center, but are simply formed in thinner layers while the trees are young, an "arrangement" which is rarely seen in other trees, because most of them grow faster in youth, and consequently form thicker concentric rings. As a matter of fact, it may be stated in this connection that, in general, trees elaborate a given quantity of lignum, or wood fiber annually. While the tree maintains a uniform quantity of foliage, the output of lignum is equal; but, as the tree trunk enlarges, the material is spread over more space, and is consequently thinner. During the early, vigorous growth of the tree the layers are thick, and, while the amount of foliage increases, it increases the supply of lignum, which is spread over a larger surface, so the layers for a time are uniform; but, as age and decrepitude ensue, the foliage and lignum decrease, and the layers consequently decrease, so that in the case of Junipers and other trees—often showing but a few green twigs annually—the layers are not thicker than a sheet of paper; in fact, in certain monster trees of limited foliage, they are hardly discernible with a lens. In the case of the present trees, to say that the concentric rings are thinner near the center than in other trees, is to formulate a characteristic of the Cypress family that separates it, structurally, from other trees in a remarkable manner, and is equivalent to saying that these trees do not manufacture, at any time, as much wood fiber as

others; and a moment's consideration of the difference in their foliage explains the reason. The leaves are the lungs—the elaborators of sap and building materials for the tree's needs. Of course, a little scale of a leaf cannot elaborate so great a quantity of material as a larger one, especially one with an expanded blade, like most deciduous leaves; hence, all these scaly, Cypress-leaved trees (except those with abundant foliage) are slow growing, fine-grained, often long-lived trees.

AMERICAN CEDARS.

THUYA.

The name of this genus is of ancient origin and sometimes written *Thuja* and *Thuia*, but as the letters *j* and *i* in such cases are given the sound of *y*, it is quite as well to write it so. Linnæus published it as *Thuja* in the body of his great work GENERA PLANTARUM, though he wrote it *Thuya* in the index, which was an afterthought and perhaps a better one. But the trees that first received the name of *Thuia*, meaning, in Greek, a tree yielding odoriferous gum, and *Arbor vitæ* among Latin writers, from their resemblance to the arborescent appearance observed in cutting the human cerebellum in a longitudinal direction. This distinction early separated them from the rest of the Cedars, and later these were again separated into genera, until a pair of species only were left, under the name of *Thuya*, and these being found only in America are often called American Cedars. One is indigenous to each of the forest developments of North America: the eastern one, *Thuya occidentalis*, stretching from New Brunswick and the valley of the St. Lawrence, westward to Michigan, and southward through the Middle States, along the Alleghany Mountains to North Carolina; the western species, *Thuya gigantea*, favored by a warmer climate, stretches from Alaska and British Columbia, eastward along the cross ranges to Washington, Idaho, and Montana to the western slopes of the Rocky Mountains, and southward through Oregon along the coast mountains to Cape Mendocino, in California. These regions nowhere approach each other nearer than one or two thousand miles, and the differences between them are so slight that Robert Brown conjectures that the separation has been perhaps recent. "There lies something deeper behind this dispersion," he remarks, "than we yet understand, and it really sometimes seems that a species may stretch to the utmost bounds of its range, cross over and take new characters to suit the new climate and physical circumstances it is subjected to, and here form a new race, in course of time to become representative species of the original stock of whose family it was once an individual." "The want of stragglers all the way over," he continues, "seems to militate against this theory; but the great central regions of America, like the center of all continents, now too dry to be favorable for the prosperity or even growth of arborescent species, might not have always been so." And he cites the remarkable resemblances which may be more than coincidences that subsist between half a dozen trees in each of these regions, scarce a prominent Atlantic species of conifer (or deciduous tree either, for that matter) but has its Pacific "analogue"—the Pacific region has by far the most lines of development present and unmatched, as in most of the Pines and Firs, and most notable, the Redwoods, nothing resembling them being found elsewhere on the earth.

34. THUYA OCCIDENTALIS, Linnæus.

ATLANTIC RED CEDAR.

This species of American Cedar is peculiar to the forest development of the Northeast, and forms most of the celebrated Cedar swamps of all that region. It is never seen in uplands, always in sphagnum swamps, the development exactly in ratio to the humidity.

The tree tapers rapidly from a large swollen base to a slender apex, the principal limbs wide apart and springing out at right angles with the body, from which droop many sweeping branchlets, whose foliage resembles that of the White Cypress growing in similar situations, and described later on.

The wood of the eastern Cedar, like that of all the family, is of a reddish hue, and is odorous, quite soft and fine grained, very durable, and therefore in much demand for fencing and for building purposes connected with the ground. Posts made of it have been known to be in serviceable condition after thirty-five to forty years' use, and fence rails last sixty years.

Doubtless it would be more extensively used if the tree attained a larger size, as it is seldom over forty to sixty feet high.

On the borders of lakes, where it has room, and it enjoys the benefit of light and air, it rises vertically, and attains a greater size than when crowded into swamps, where the trunk is apt to become curved. Near the base of old trees two or three prominent ridges usually form, connected with the principal roots. The bark upon the body is slightly furrowed, smooth, and very white when the tree stands exposed, and this circumstance has given the tree, often, the name of "White Cedar;" but as the wood is reddish, and there are so many white-barked trees, it is best to call this a Red Cedar, from the color of its wood. It is also often called Arbor Vitæ; but that name were better to be reserved for the compact, bushy Chinese trees, with vertical branchlets, and belonging to the genus *Biota*.

A noted locality for this Cedar is Goat Island, which divides the cataract of Niagara.

This American Cedar was introduced into Europe with the first productions from the New World, and the superior beauty of its foliage at once made it a prime favorite in the ornamentation of pleasure grounds and for planting in marshes. Being so long cultivated, a great many varieties have sprung into existence—some of them so different from the original that they would readily be called distinct species if found in nature.

35. THUYA GIGANTEA, Nuttall.

GIGANTIC, OR PACIFIC RED CEDAR.

[See Illustrations Nos. 20 and 21.]

This is the Pacific Coast analogue of the eastern Red Cedar, and for a long time was confounded with that species, but it is found to be specifically separated, differing remarkably in its enormous size, well developed trees attaining a height of one hundred to one hundred and fifty feet, with a swollen base ten to twenty feet in diameter.

Its headquarters are in the low, rich woods and swamps of the North-

west, from Alaska southward along the Coast Ranges to Cape Mendocino. In British Columbia, opposite Vancouver Island, it forms a great part of the swamp forest, dividing the privileges of the situation with the big Tide-land Spruce described. It follows along in the wet spots of the northern cross ranges through Idaho and Montana to the western slopes of the Rocky Mountains, where at high elevations it becomes dwarfed, and where it was mistaken for the eastern species. In its headquarters may be found trees of magnificent proportions, straight, tapering, tall, and the upper third clothed with bright green foliage.

A noted tree, a few miles south of Seattle, was utilized by the Hudson Bay Company in the early days of western occupation for a telegraph pole, and until the discovery of the big Sequoias later, it was doubtless the largest telegraph pole in the world, being over fifteen feet thick at base.

The limbs of the *Thuya*, with two-ranked branchlets forming horizontal sprays of fan-like foliage, and other characters of the species, cause it to be often mistaken for the next tree to be described—*Libocedrus*—and, in descriptions of early explorers, the two trees were often confounded. But the characters of the small, thin valved fruit-scales, six of them seed bearing, distinguish it in addition to the distinctly different range of the two trees—the Gigantic Cedar, widely distributed through the wet portions of the Northwest; the Post Cedar confined to drier localities of southern Oregon and throughout California.

The Gigantic Red Cedar is sufficiently represented by large timber trees along the north coast of California to be of much interest to us. It mingles with the Coast Redwood, Douglas Spruce, and the Grand Fir, while it is itself one of the largest and most valuable trees of the region.

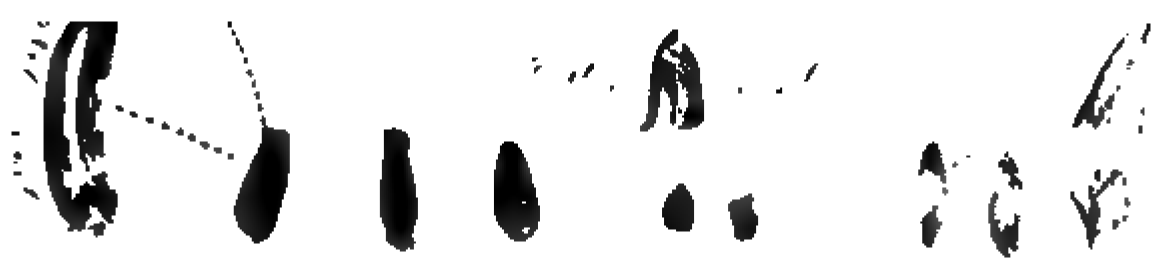
"As a useful tree," writes the distinguished botanist, Robert Brown, "it stands preëminent in the Northwest in the estimation of the Indians and backwoodsmen. The Indians readily fashion its light, soft timber into canoes, walls for their lodges, and in the manufacture of troughs, bowls, etc., while from its strong bark they make clothing, blankets, mats, and thatches for their lodges." "Nothing so thoroughly expresses the enormous size of the tree," continues Mr. Brown, "than to see the large war canoes which the Indians fashion out of a single trunk, often forty to sixty feet long."

In preparing to cut down one of these trees, our modern lumberman, who does not desire the hollow, lower portion of the tree, cuts notches in its sides, into the highest of which he inserts a stout plank three feet long with an iron shoe, that, when the plank is depressed, grips into the tree and makes a firm footing for the workman (as represented in the accompanying illustration).

The timber of the Gigantic Cedar is well nigh indestructible in contact with the soil, or under water, as remarkably exhibited along the north coast, notably at Shoalwater Bay, where submerged trees of this species are standing in groves whose age must compass many centuries, though their exact age can only be conjectured. These trees certainly belong to the existing species, the nearest living trees being the same.

They evidently grew in long, past centuries when the surface was above water.

A slow sinking of the coast seems to be still proceeding, the tide annually rising higher and higher, killing the trees, which remain per-



California Post Cedar:
Libocedrus decurrens.

No. 23. -Bearing branches from Sierra Valley, Sierra County, California. Scales, seeds, and a twiglet with its scale-like leaves and minute male flowers, enlarged.

fectly sound, and the uncovered portion becoming so well seasoned as to be of great value. Continued and careful examination of these shores may afford important information concerning changes of level; several of which have certainly taken place, as proven by alternate layers of marine shells and of logs and stumps, the latter in natural position, which form the cliffs along the shore, and which are two hundred feet or more in elevation.

So far as late geodetic surveys of the northwest coast have proceeded, no evidence is found to support the favorite theory of certain alarmists that these changes have been sudden or violent, as from cataclysms or earthquakes. On the contrary, the indications are that the submergence has been gradual, and in late Pleistocene times measurable by thousands not millions of years.

The Gigantic Cedar has been favorably introduced abroad, and is prized for its beauty and usefulness. The wood is very light, soft, not strong but compact, easily worked and, as shown, exceedingly durable. It is in demand wherever its merits are known for fencing, log house or other buildings, shingles, interior finish, cabinet work, casks, etc. In the vicinity of its growth it is the one tree of all others chosen for making boats, water troughs, conduits, etc.

The cones of this tree are cinnamon colored, small, until opened narrowly oblong, four to six lines long; when opened, the three pairs of thin concave fertile scales are widely expanded, making nearly a globular bur. They are borne erect, or nearly so, along the drooping branches, and terminating the strongest branchlets. They are composed of five pairs of unequal, very thin, oval, convex scales, the lowest and highest pairs very small and barren, all in two ranks, imbricated or overlapping slightly at their edges until expanded; seeds, two to each scale, small, elongated, but seemingly sub-orbicular by the presence of broad, lateral wings; leaves, small, scale-like, and decurrent in two unequal opposite pairs of rows, the upper and lower row on the branchlets minute, the lateral rows larger and keeled, all with a resin gland on the back. The male flowers are numerous and very small, not over one line long, composed of four pairs of opposite scales, with four minute anthers under each.

36. Libocedrus decurrens, Torrey.

CALIFORNIA POST CEDAR.

[See Illustrations Nos. 22 and 23.]

This common and beautiful tree of the California mountains, in general appearance, bark, foliage, and wood, resembles the Gigantic Cedar, but is really quite distinct in important characters. It becomes a tall, pyramidal tree in open situations, limbed to the ground, but in forests it becomes limbless, and attains a height of one hundred to one hundred and fifty feet, with a clean whitish shaft, but slightly tapering four to six feet in diameter at base.

The branches, quite numerous in youth, bear their branchlets in two ranks, making flat, mostly horizontal, sprays of dark green foliage. The cones are pendent from the side pinnæ of principal branchlets and are oblong oval, one half to one inch long, composed of three pairs of very unequal, opposite scales, the lower short (often absent) and sterile, the mucro at the apex, divaricate and resembling a spur, the middle pair

expanded to the full length of the cone, thickened, semiterete and gibbous at base, bearing on their inner faces the four seeds—a pair on each scale—the upper (or inner) pair of scales sterile, much modified, compressed laterally and connate, forming a septum, or partition, between the pairs of seeds and their long wings. Surmounting all at the apex of the cone, there is a pointed vestige of a fourth pair of scales. All of the scales bear a small, deltoid protuberance near the apex on the back, the termination of the outer or bast tissue of the scale.

Examination of the fertile scales of *Libocedrus* reveals the two layers of quite different tissue closely agglutinated; the outer one, the epidermis, not so extensive as the inner, appears as if shrunken away from it, leaving a narrow space uncovered all around.

The seeds are oblong lanceolate, four to six lines long, unequally two-winged; the outer wing but little longer than the seed, the inner broad and long, nearly equaling the scale.

The branchlets are at first flattened horizontally and clothed with scale-like leaves, their bases prolonged downwards (suggesting the specific name of *decurrens*), dimorphous, the lateral rows without glands, carinate, and nearly covering the narrowed, flattened, and obscurely pitted inner ones.

The male flowers numerous and terminating, the branchlets are ovate three to four lines long, yellowish, and composed of twelve to sixteen scales, with four globular anthers beneath each.

The geographical center of the Post Cedar is about central California, on the Sierra Nevada. It ranges northward to a few of the cross ranges in southern Oregon, and southward to the San Bernardino and Cuyamaca Mountains, being sparsely found in the Coast Ranges, but not so far north as Mendocino—the species never quite mingling with its prototype, the Gigantic Cedar of that region.

In the Sierra it flourishes at elevations of four thousand to six thousand feet, in Oregon a thousand feet lower, and in Southern California as much higher, everywhere preferring dry, open situations for the display of its graceful spires, though often found with other trees, but not crowding them, and never closely set in a forest.

This tree, very valuable in its best estate, is often attacked by a species of peculiar fungus, called "dry rot," that perhaps enters the tree from its roots. It attacks the cell contents of the wood, and kills sections in rounded masses, reducing them to powdered, brown, cinder-like refuse, disposed in long chains often through the entire length of the tree.

Trees affected by dry rot lose the bright appearance of the bark, and become reddish and dingy, giving notification to the woodcutter. Cutting them down arrests the rot, and often the timber is not much injured for posts, fencing, and many other purposes. It splits readily, and sound trees make excellent finishing lumber; variegated boards, composed of the dark reddish heart-wood, bordered with a stripe of the very white sap-wood, being a favorite material in cabinet work and for interior finish.

Upon the slightest abrasion or application of working tools, this Cedar gives off a delightful perfume, which suggested the generic name of *Libocedrus*, meaning Incense Cedar.

Like other Cone-bearers, this tree often skips a season, bearing no fruit, much to the detriment of seed collectors. Robert Brown, the distinguished botanist, in 1865, "climbed or cut down and examined upwards

of one hundred trees, and did not get more than a dozen poor cones, though from the remains under the trees they seem to have fruited abundantly the season previous."

In Oregon this tree does not have a good reputation for durability (perhaps a mistake), intelligent farmers assuring me that fences built of it could be pushed over in four years. Certainly, I know of fences and underpinning of houses in California that have endured for twenty-four years, and are apparently as firm as ever.

The Post Cedar is a great boon to the California farmer and stockman, their first improvements being largely aided by selections of Post Cedar from the nearest forest. It is favorably cultivated both at home and abroad as an ornamental tree, for which its symmetrical, pyramidal form, and its dense, dark green foliage eminently qualify it.

It is fond of sparsely timbered plateaus of medium elevation, or open valleys like the Yosemite, where, on its broad floor amidst the scattered Yellow Pines and Kellogg Oaks, it forms one of the most charming features of that sequestered region. Near the Cathedral Rock, on the right after passing through the gateway, the visitor meets with several unmistakable specimens of this noble species, rising like verdant cones to the height of fifty to eighty feet, their broad bases nearly resting upon the flower-strewn valley.

When these characteristic California trees are fruiting, as they do generally every season, and they are ripening their numerous, yellowish, pendent cones, like golden ornaments during the month of September, their appearance adds a charm and attraction to any landscape. In the long chain of valleys beginning with Yosemite and including Tahoe, Sierra, Mohawk, American, Big Meadow, and Lassen Valley, lying near the backbone of the Sierra Nevada Mountains, the *Libocedrus*, with its peculiar, lovely characters forms a never to be forgotten feature.

There are two or three other living species of *Libocedrus*, or Incense Cedar: one in New Zealand, one in the mountains of Chili, and a third or perhaps a marked variety of the last in the mountains of Patagonia. The researches of geologists show that several species existed in far northern regions during Miocene times, coeval with Sequoias, Taxodiums, Magnolias, Liquidambers, and others. The extinct species were seemingly all of colossal proportions.

GROUND CYPRESSES.

[See Illustration No. 24.]

We come now to the consideration of a rare, very ornamental, and valuable group of trees composed of two families found on opposite sides of the earth—one genus of ten species in eastern Asia, the other of three species in America. No trees of other groups excel, or scarce compare, with these in loveliness of form, pliability under cultivation, or in the excellence of the wood. The general appearance is that of a perfect broad-based cone, the trees usually retaining their branches, which are bordered with two ranks of flat, horizontal, fan-like branchlets, all diminishing gradually from bottom to top of the tree, which usually terminates in a slender point, swaying with every breeze, the light green foliage decked throughout with bead-like, minute cones, in their season.

The Ground Cypresses were taken out of the large family of *Cupressus* in 1842, on the score of their having the branchlets in two ranks, as

stated; the cones maturing in a single season; the scales thin and bearing each but two or three seeds, which are more or less winged; leaving the true Cypresses a compact genus with branchlets not two-ranked, cones requiring two years to complete their growth, the scales thick and bearing numerous wingless seeds.

It was found that the trees so segregated (the Ground Cypresses) were also divisible, upon characters mainly of the seed, into two genera that were also separated geographically by a semidiameter of the earth.

37. *Retinospora*, Siebold. Oriental Cypress.

This beautiful family is represented by ten species, mostly of small trees or shrubs, the pride and pets of the tree-loving Orientals of China and Japan. Many of the trees are so small that they make lovely little house plants, conveniently carried about in pots and boxes, as is the custom of the Mandarin, who often arranges his garden or park in very different, not to say grotesque, forms to suit his fancy.

Other species become very large trees, as in the great Japan Cypress, constituting the greater part of the forest of the rich island of Niphon. On the central mountains it often attains the height of one hundred feet, and its timber is so white, aromatic, firm, and fine grained, with a brilliancy under polish equal to that of satin, that the Japanese prize it above all other woods, making their most valuable furniture, as well as constructing their temples and idols of it; and they also set apart certain of the trees exempt from destruction and dedicate them to the Sun-god, under the name of *Fusi-noki*, tree of the sun.

This is the famous aromatic satin wood of the Orient.

38. *Chamæcyparis*, Spach. American Ground Cypress.

[Name from the Gr. *chamæ* (on the ground) and *cyparis* (Cedar), *i. e.*, Ground Cedar.]

This genus is exclusively American, and, like *Thuya*, has representatives in both the eastern and western development. The east has one species, *Chamæcyparis sphæroidea*, Spach ("White, or Ground Cedar"), a beautiful tree of medium size, found in cold, dense swamps of the farther east, from Maine down along the Atlantic to Florida, and westward along the Gulf to near the mouth of the Mississippi.

This tree is especially at home in the great Dismal Swamp, near Norfolk, Virginia, sharing the dense sphagnum bottom with the Bald Cypress, while the beautiful Tupelo and the Red Maple circle about them. When confined closely the shade is so dense as to entirely preclude the light, and the trees then trim themselves to a great height; but such behavior is not natural to this genus, always loving to spread out its lower branches with plenty of room.

The bark of young trees is thin and reddish, like that of a grape vine, becoming thick, and flaking off in age. The leaves are in two ranks, very small, scale-like; the male flowers scarcely visible in the forks of the branchlets on mature trees; the cones, about the size of a small pea, are quadrangular, of a greenish tint until autumn, then becoming bluish just before discharging the fine winged seeds.

The wood of this tree is most valuable. It is always close grained—a general character of the slow-growing Cypress tribe—very white, soft, highly aromatic, durable, and easily manufactured, hence in great

Lawson's Cypress.
Chamæcyparis Lawsoniana.

No. 24.—Bearing branches from trees in Mendocino County, California. A twiglet with its small scale-like leaves, the thick cone scales, and a naked seed, enlarged.

demand for many purposes. The wonderful fragrance of the wood is retained as long as it is kept dry, but frequent changes from wet to dry do not affect the durability, shingles and weatherboarding being found serviceable after the lapse of sixty years.

39. CHAMÆCYPARIS NUTKÆNSIS, Spach.

NOOTKA, OR ALASKA CYPRESS.

The forest development of the Northwest contains two species of Ground Cypress, one northward and somewhat abundant in its headquarters around Puget Sound; the other southward and extremely local about Coos Bay, and with a few groves along the coast into the northern counties of California and eastward as far as Mount Shasta.

These two species are classed by Gordon, in his "Pinetum," as late as 1875, with the genus *Cupressus*, principally because the seeds are more in number than two each to the scale; this distinguished author very singularly ignoring the other important vegetative characters separating the genera as shown.

The Nootka, or, as it is often called, the Yellow Cypress, extends from its headquarters northward to the Alaska Islands, and southward along the coast mountains to a few miles within the limits of California, notably near the tributaries of Mad River in Humboldt County. Interior it ranges at higher elevations on the Cascade Mountains. In August, 1890, Messrs. Muir, Smith, and Piper detected fine specimens of this tree on the southern slope of Mount Rainier at an altitude of six thousand feet.

At its best, the Nootka Cypress becomes eighty to one hundred feet high, with a diameter of three to five feet. Its general appearance is that of a cone gradually tapering to the summit, but not so slender as the next to be described. The branches are less flattened, the leaves larger, the cones larger with four to six scales, which are greener and more convex, with a more prominent umbo or boss on the center of the thickened apex.

The wood is light, hard, close grained, easily worked, and durable, of a satiny sheen under polishing tools; in color a bright, clear yellow. Besides, the wood possesses an agreeable, aromatic odor, which it retains until dissipated by moisture. After the enumeration of the qualities mentioned, it is not strange that the Yellow Cypress wood is in good demand at the price of $70 to $100 per thousand, and dealers hail with delight the intelligence that an exploring party in the Olympia Mountains of western Washington report the discovery of a large forest of "Alaska Cedar," which, when developed, will become a source of great wealth to the Northwest.

40. CHAMÆCYPARIS LAWSONIANA, Parlatore.

LAWSON'S CYPRESS, OR PORT ORFORD CEDAR.

[See Illustration No. 24.]

Preëminent among ornamental trees, the world over, is this lovely denizen of the Northwest, including California. No tree is better known or more highly esteemed, it would appear, from the diligence with which

the seeds of it are still collected for Old World markets, and the frequency with which it is met in all our parks, lawns and other ornamental grounds.

The Lawson Cypress is distinguished at sight by its perfectly conical shape, the numerous limbs divided into opposite ranks of nearly horizontal fan-shaped branchlets gracefully bending downwards, exposing the upper surface with its bright green foliage, and, in the season, its many small, globular, yellowish cones. The limbs diminishing towards the top, the tree ends in a slender shoot, nodding and swaying before the wind.

This family of trees may not be clipped with the shears, as in the true Cypresses, the half-remaining flat fans being unsightly; so they are used only for standard trees in open parks, or for windbreaks, for which they are admirably adapted. Formerly the Lawson Cypress was abundant around Coos Bay, but fire and the lumberman's ax have removed the most of them. The shipment from the vicinity in early times gave it the name among lumber dealers of Port Orford Cedar; and the revered Dr. Kellogg used to call it "Ginger Pine," from the spicy fragrance of the timber.

Scattered groves are found southward in the coast forests until it meets the northern prolongation of the coast Redwood, in Del Norte County, with a few groves overlapping as far southward as Mad River, in Humboldt County. Eastward a few trees are found scattered along mountain streams at the unexpected elevation of nearly four thousand feet, notably on the Trinity Mountains, near Mount Shasta.

All hunters of the past twenty-five or thirty years who have ranged those regions for deer and bear are familiar with Scotch Camp, about twenty miles west of Sisson, and a noted locality for this beautiful and rare tree. In the vicinity of other trees, the Lawson Cypress hardly develops any body limbs, the few short, drooping sprays practically not at all affecting the timber; the wood being straight, very close grained, with a satiny gloss. When all of these qualities are supplemented by a light creamy color and a wonderfully powerful aromatic odor, which is at once extremely delightful, and a certain insecticide, a better "all around tree" can scarcely be imagined.

Foreigners regard the Lawson Cypress as one of the finest trees introduced to them from the Great West. They especially prize it on account of its bright green aspect under all conditions, thriving well almost anywhere, and always making a generous display of its lovely depending plumes.

Although this is a California tree in part, and of great interest to us, so much of its history has been given in the discussion of the genus *Chamæcyparis* that further description will be omitted, and the reader is referred to the illustrations of this most beautiful and valuable of trees.

TRUE CYPRESSES.

CUPRESSUS.

[See Illustrations Nos. 25 and 26.]

After taking a number of aberrant forms away from the old, ante Linnæan genus of *Cupressus*, quite a distinct and natural group of species remain, distinguished as trees and shrubs having their branches scattered

more or less, and not in two ranks; leaves very small, scale-like, opposite in four lines, making the branchlets appear more or less quadrangular; cone globose or polyhedral, of divergent, ob-pyramidal and peltate scales, the cone requiring two years to mature; seeds numerous, six to twenty to each scale, angular and narrowly winged.

The Cypress family, because of their slow, uniform growth, their light and airy appearance, with deep green foliage, have become great favorites in cultivation, added to which the fineness of their branchlets admits of their being clipped with the hedger's shears without injury in the season, and shaped into hedges, windbreaks, towers, temples, cages, or almost any fanciful shape at will.

The Cypresses comprise about fifteen species, widely distributed over the earth, and in diverse regions as regards elevation. Three species are in China and India; three in the Mediterranean region; eight or nine in America, all in the dry western or southern portion; five of them in Guatemala and Mexico; the remaining five in Arizona and California.

The great Indian Cypress of the Bhotan Mountains of upper India becomes a tree of a hundred feet in height and six to eight feet in diameter. The wood is yellowish, close grained, tough, exceedingly fragrant, and very durable, much prized by the Orientals in manufactures, and the spicy branches are burned as incense in their temples.

The Funeral Cypress of China is a singular tree; when young it is upright, rigid, and pyramidal in outline; later it begins to send out long, slender branchlets that depend to the ground like the Weeping Willow, and like this tree it is much used for cemeteries.

The *Cupressus sempervirens* of Syria is a valuable timber tree, still quite common in Palestine, and is doubtless the "Cedar" of Bible times used in the building of Solomon's temple, and not the Cedar of Lebanon, as the latter is a notoriously poor timber tree.

Two or three of the Mexican species are large and valuable trees, notably the one on the slopes of Orizaba Mountain, at an elevation of seven thousand to eight thousand feet.

41. Cupressus Arizonica, Greene.

ARIZONA RED-BARKED CYPRESS.

An interesting species of Cypress was discovered on the San Francisco Mountains of northern Arizona (1880) by Rev. E. L. Greene, and by the writer the same year on the Santa Catalina Mountains, Arizona.

Subsequently it was detected by C. G. Pringle on the Santa Rita Mountains, and in 1882 it was found in abundance and of large size by the writer on the highest peaks of the Chirricahua Mountains, in southeast Arizona.

Just previous to all these discoveries (1879), Dr. Palmer found on Guadaloupe Island, in the Pacific, three hundred miles off the peninsula of Lower California, a large fruited Cypress, which at first was taken for *Cupressus macrocarpa* (Monterey Cypress); but soon after Professor Watson determined that it was distinct, and published it as *Cupressus Guadaloupensis*. Strange to say, certain botanists of the East refer this Arizona Alpine Cypress to the *C. Guadaloupensis*, as though the latter species was identical with all these trees found on the peaks of Arizona from end to end of the Territory.

This new Cypress is particularly distinguished by having the gray outer bark of the limbs peeling off in thin flakes, leaving the thin inner bark with a smooth, claret-red surface, at first spotted with yellow, where the flakes have most recently fallen away. This character recalls the peculiarity of the Manzanita and Madroña limbs.

The cones are very large, also, an inch or less in diameter; the scales with very prominent umbos, or leaf-like points.

In the published description of *Cupressus Guadaloupensis*, the branches are described as "drooping, with very slender branchlets;" but in our Chirricahua (Arizona) specimens the branches are not drooping, and the branchlets are short, stout, and beautifully quadrangular, caused by the four rows of prominent pointed leaves.

The trunks of all the trees—some of them forty to sixty feet high—retain the bark, which is grayish, of medium thickness, and disposed in longitudinal ridges, dividing into sections a few inches in length by diagonal reticulations, imparting to the trees a curious latticed appearance.

The insular species is already in cultivation in the bay cities of California, and is highly esteemed; the young trees with their twigs coming out in four ranks, the foliage thus becoming a collection of quadrangular pyramids, all of a glaucous green color of great beauty. The Arizona Red-barked Cypress is yet to be collected in fruit, and its merits tried by cultivation.

42. CUPRESSUS MACROCARPA, Hartweg.

MONTEREY CYPRESS.

[See Illustrations Nos. 25 and 26.]

Thousands of visitors to the "Golden West" have taken the "Seventeen-mile Drive" from Monterey or Pacific Grove to Cypress Point to see the wonderful trees there, and a right royal treat it has proved to them.

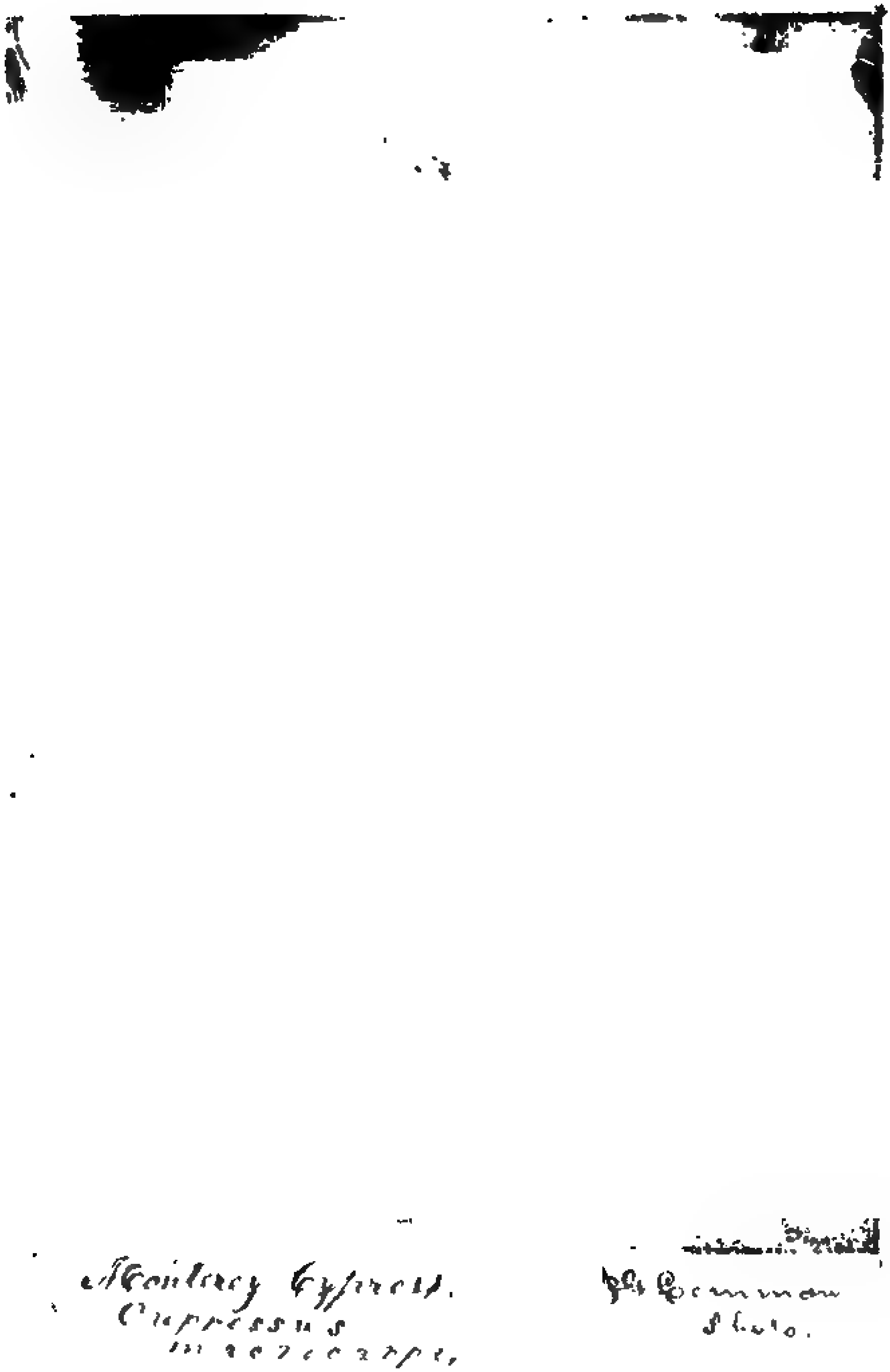
For miles the well traveled road meanders along the rocky beach and among these arboreal monarchs of past and conquered centuries.

Great trees, forty to sixty feet high and four to six feet in diameter, are seen. Then again, dense groves are entered, while, crowning the exposed points and beetling cliffs, are met a phalanx of sturdy warriors, their crowns of foliage clipped and molded into fantastic shapes by the ocean storms. Yet the trees are stubbornly holding their ground century after century.

The furious winds of winter coming up out of the sea and meeting with the shattered rocks of the cliffs, are split and separated by the former into keen, cutting currents that plow through the forest inland, hewing down or bending out of the way all vegetation in line of their course, traveling through the Cypress trees, shaping their foliage into platforms or benches, placed now on one side, now on the other of the shaft, the platforms rising one above the other to the tabular top.

It is as if a rounded head of solid verdure were cut through at irregular places, and the greater portions removed, leaving the fragments in picturesque array.

Interior and in all sheltered localities the Monterey Cypress becomes one of the most symmetrical of pyramidal trees. In San Francisco, and in all the settlements up or down the coast, no tree is more fre-



No. 25.—A small tree from a park in Oakland, California. Showing the symmetrical form of the species under cultivation.

quently met with and more utilized, principally for windbreaks and hedges, though often purely for ornament.

Only at two points on the coast of California does the forest come down to the sea in such profusion, and these localities are Point Pinos, where the unique Monterey Pine crowds down to the crested waves, and the other is but a few miles southward—Cypress Point—where this unrivaled Cypress battles with the winds, both species seeming to enjoy rather than to suffer the hardships of their location.

The Monterey Cypress is a fine example of the great age and decrepitude to which a tree may become before it gives up the struggle of life. Now and then a tree is met with that has but a few live sprays of foliage, and such trees, for many past years, have consequently been putting on but thin layers of wood. And the new material is applied, not all around the trunk, but only on portions connected with the live limbs; and these portions become high raised and carry the sap, leaving the rest of the trunk unfurnished.

The limbs are treated similarly, and the life current, changing like a stream from side to side, sharp, angular turns are frequent in the limbs; the lower ones succumbing at length and remaining dry, hard bayonets, like *chevaux de frieze* protecting a sentinel tower.

No tree is better adapted to, or more preferable in, reforesting the coast hills of California than this Monterey Cypress.

The swift growing Eucalyptus is largely planted, and now covers broad acres of the Oakland hills with dense forests; but future citizens could make better use of Cypress than they can of Eucalypti, because the timber of the latter is almost unworkable—being coarse, tough, cross grained, subject to cracking and warping—while the Cypress is easily worked, fine grained, hard, durable, and agreeably fragrant.

Like the Monterey Pine, this peculiar Cypress is found on two or three other limited and neighboring capes, and a variety of each is found away down the coast, on the Channel Islands of Santa Barbara, suggesting not so much the migration of these trees to those islands, as the comparatively recent separation of those islands from the main land, once presumably well stocked with these trees.

The cones of the Monterey Cypress are usually clustered near the ends of branchlets on short foot stalks, frequently turning to a shining bronze color the second season. They are variable in size, usually ovate and about an inch long; the young cone scales with foliaceous tips; seeds numerous, ten to twenty to the scale, or one hundred to one hundred and fifty to the cone, small, angular and narrowly winged.

As with most plants under cultivation, the Monterey Cypress has already developed several marked varieties. One may be named:

Variety *angulata*, distinguished by having the scales nearly flat, giving the cone a hexagonal form if composed of three pairs of scales, or polyhedral if containing more scales. The leaves are very small and obtuse. This form is frequently met with and proves a fine standard tree.

OTHER CALIFORNIA CYPRESSES.

The other Cypresses indigenous to California are small trees or bushes, fifteen to forty feet in height. One, *Cupressus Goveniana*, or Mr. Gowen's Cypress, with spreading, pendulous branchlets, smaller cones, leaves,

etc., found sparsely along the coast mountains from Humboldt County to San Diego, and into the peninsula of California.

A third species, *Cupressus Macnabiana*, is a small tree, ten to thirty feet high, with short, slender branchlets; leaves small, conspicuously pitted on the back; and small cones, with thin, prominent bosses. It is indigenous to the secluded region about Clear Lake; also, reported from Mount Shasta, but the latter locality lacks confirmation.

Both these trees are in cultivation, and are favorites where small growths are desired.

CUPRESSACEÆ—Concluded.

Tribe 3. JUNIPERINEÆ.

THE JUNIPERS.

[See Illustrations Nos. 27 and 28.]

This, the last tribe of the multitudinous *Cupressaceæ*, or Cypress-like trees, is peculiar in being so compact and uniform a group as to be generally classed as a single genus (*Juniperus*), though comprising a large number of species. The fruit is a much modified, almost consolidated cone, either berry-like and juicy, or dry and crustaceous.

The Junipers are evergreen, slightly resinous trees or shrubs, found in temperate and frigid regions of both hemispheres, generally in arid interior localities; its fine branchlets and small, scaly leaves being better adapted to hot, dry climates than would broad, expanded leaves—at once inviting the keen rays of the sun and killing the plant.

Some authors divide them into three subgenera: *Oxycedrus* (the true Junipers), with leaves in whorls of threes; *Sabina* (the Savin Junipers), with leaves in opposite pairs; and *Cupressides*, with leaves in four rows.

There are about thirty species, but some have been in cultivation so long that many marked varieties have arisen.

Twenty of these species are found in the Old World (two of these apparently extending across Northern America), four or five are Mexican, and as many more are within the limits of California.

The wood of all the Junipers, it is hardly necessary to say, is exceedingly fine grained and durable; it is hence well adapted and much used for fence posts, underpinning, log conduits, etc.

The bark is usually very thin and readily separated longitudinally into shreds or long rope-like strips. The heart-wood is a bright red or brown color, winning for the Junipers often the name of Red Cedar.

43. JUNIPERUS PACHYPHLŒA, Torrey.

The thick-barked Juniper of Arizona and New Mexico, southward to Mexico, is peculiar in having its bark thick, persistent, and deeply cracked into square checks, not unlike the White Oak. The fruit is large, nearly a half inch long, and having a sweetish taste; hence, much prized by the aborigines for food. It is a tree thirty to fifty feet high, branching near the base with long, spreading limbs.

44. Juniperus occidentalis, Hooker.

WESTERN JUNIPER.

The Western Juniper is distributed from the mountains of eastern Oregon southward along the Cascades and Sierra to the San Bernardino Mountains at elevations of seven thousand to ten thousand feet.

It becomes a small tree thirty to forty feet high, with spreading branches, and small, blue-black resinous berries. This Juniper is very serviceable in furnishing fence posts, rails, etc. The fruit is small, blue-black, resinous, and fleshy. (See illustration No. 28.)

45. Juniperus Utahensis, Lemmon. (*J. Californica*, var. *Utahensis*, Engelmann.)

DESERT JUNIPER.

This desert-loving Juniper inhabits the many longitudinal ranges of mountains traversing the great Fremont Basin, and comprising all of Nevada, the western portion of Utah, and an eastern slice of California.

Usually, this species is found as a large bush freely branching from the base, but often it becomes a considerable tree, twenty to thirty feet high, and with a trunk clear of limbs for several feet. This Juniper, with the similar conditioned Nut Pine, form the most available and almost the only lumber and fuel supply for the interior hamlets of this large region.

The bark of the tree is tough and shreddy; the berries reddish, dry at maturity, and very small, three to four lines in diameter; the leaves in threes, minute, and close appressed.

(Illustrated as var. *Utahensis* of *J. Californica*, on Plate 28.)

46. Juniperus Californica, Carrière.

CALIFORNIA JUNIPER.

[See Illustration No. 28.]

This somewhat local species is usually a large shrub much divided from the base, but sometimes becoming a standard tree twenty to thirty feet high.

It affects dry, rocky, or sandy barrens, and creeps from them into contiguous plains as in portions of southern California and northern Arizona, where it especially abounds in connection with Mesquite, forming the principal fencing material and fuel of the region. The wood of this Juniper is light, soft, close grained, compact, and very durable in contact with the soil. The heart-wood is light brown, tinged with red; the sap-wood bright, clear white. The berries are reddish, dry at maturity, oblong ovate, five to seven lines long, of four to six reduced scales, usually with one large, brown seed, with a thick, bony shell. Leaves ternate, short, and thick.

47. Juniperus communis, Linnæus. (Var. *Alpina*, Engelmann.)

ALPINE CREEPING JUNIPER.

For the sake of completing the list of Junipers, this variety of a large upright Juniper must be admitted, though it is only a prostrate, creeping shrub, found only on a few of our high peaks. The leaves are large for the genus, about half an inch long, rigid, pungent, and spreading; the berries are very small, dark blue, juicy, or fleshy.

This is one of those few vegetable forms remaining to show that all the world's products have a common origin, this Juniper being found on alpine peaks of both continents and northward to the arctic circle. It is remarkable as being the only arboreous product of California that is indigenous elsewhere. Not one of all our Pines, Spruces, Hemlocks, Firs, Cypresses, Junipers, or Yews, save only this dwarfed, prostrate variety of a Juniper, extends across the long north and south barrier of the Rocky Mountains, separating the American flora, and prohibiting any but Mexican species to reach the Northwest and be nourished to undue development by its favoring conditions.

Sub-order 3. TAXACEÆ.

YEWS AND THEIR ALLIES.

[See Illustrations Nos. 29 and 30.]

This order of Cone-bearers is really very numerous, but as its members are principally in the Old World and the southern hemisphere, it does not seem of much importance to us.

It comprises four tribes, with twelve genera and about ninety species. Among them are the great Podocarpus (foot-stalked fruit) genus of the southern hemisphere, comprising fifty species of mostly large trees; the Dacrydiums of nine species in the East Indies, and the curious Prince Albert Yew of Patagonia, besides the True Yews of five genera; two of which alone are represented in the western development by one species each, both in California.

Taxus, Tournefort.

TRUE YEW.

The True Yews are very numerous as regards species in the Old World and southern hemisphere, with two species in the eastern United States and one in California.

The principal Old World Yew is *Taxus baccata*, Linnæus, found in most parts of Europe at elevations of one thousand to two thousand feet, from the mountains of Greece and Italy to Spain and England, and even upon the Scandinavian Mountains between Norway and Sweden. Usually a large bush, it often becomes a small tree, with a short stem and an ample head composed of many branches densely set with drooping branchlets and dark green leaves in two rows.

Several varieties have been produced by cultivation, principal of which is the Irish Yew, called by Hooker, *Taxus Hibernica*, with strict, erect branchlets, closely compressed like a Lombardy Poplar; the leaves not

No. 26.—Bearing branch from a tree in the extremely local home of the species around Monterey Bay, California. A twiglet with its small scale-like leaves, the thick scales and minute seeds displayed.

two-rowed, but scattered and in tufts; the berries, also, are oblong, not rounded as in the Common Yew.

The principal Yew of the Eastern States, *Taxus Canadensis*, Willdenow, is distributed throughout the provinces of Canada and the New England States, extending southward as far as Maryland. It never becomes more than a large spreading bush of no forestal importance. The Yew of the Southern States, *Taxus Floridiana*, Nuttall, becomes a small tree, but is limited to a narrow section of western Florida, along the Appalachicola River, where it is much esteemed for the purposes in which strength and elasticity are desired.

48. Taxus brevifolia, Nuttall.

PACIFIC YEW.

[See Illustration No. 30.]

This Yew is a special product of the western development, and becomes quite a large tree in favorable circumstances, measuring two to four feet in diameter and seventy-five to eighty feet in height. It affects the borders of streams in low, rich woods of western Washington and Oregon, extending northward to British Columbia; eastward, as a small shrub, to Idaho and Montana; and southward, as a considerable tree, along the California Coast Ranges to the Santa Cruz Mountains, and along the western slopes of the Sierra to Yosemite Valley, notably upon the headwaters of the Sacramento River, near Shasta, and all along its upper tributaries.

The Oregon Indians, singularly enough, call the Yew by names meaning "fighting wood," because its wood is preferred by them for making bows, and the botanical name of the genus Taxus is said to be deprived from the Greek word *toxon* (a bow), on account of the use the ancients made of the wood, but most probably the name is derived from the Greek word *toxicum* (poison), the common Yew of Europe being considered poisonous.

As might be inferred, the wood of the Yew is very strong and elastic; the bark is extremely thin and scaly; the branches long, often extending far out over a stream; the branchlets long, slender, and drooping, with yellowish bark, and the half-inch acute-pointed leaves in two ranks.

The fruit is composed of a small, fleshy, bright blood-red, edible cup, three to five lines in diameter, with a solitary, ovate, hard-shelled seed, two to three lines high, sitting like an acorn—except that it is free—in the bottom of the cup.

The so called berries of the Yew are sweetish to the taste and much prized by the natives for food.

This singular tree is rarely met with of large size in California, being two to three feet in diameter, and trees even four feet in diameter have been noted.

The Yew is particularly distinguished for its heavy, hard, strong, elastic, and durable timber, which is used by Indians in making bows, paddles, spear handles, and fish hooks. The white people utilize it for fence posts, bridge timbers, oars, spring poles, binding poles for loading wagons; in short, for any and all purposes where great strength and exceeding elasticity are required.

TORREYA, Arnott.

FALSE NUTMEG.

This genus comprises four species, found in Japan, China, Florida, and California, respectively. They are usually small trees of a heavy odor, and a one-seeded drupaceous fruit, that both exteriorly and interiorly resembles a nutmeg, but is nothing like it in taste, being strongly terebinthine and aromatic. The False Nutmeg affects borders of swamps or stream banks. When the trees are cut, there spring up many vigorous shoots from the roots, like the Coast Redwood.

The genus *Torreya* commemorates Dr. John Torrey, the distinguished botanist, who, with Dr. Asa Gray, issued the "North American Flora."

The False Nutmeg of Florida is found scattered in western Florida, in company with the Southern Yew described, along the eastern banks of the Appalachicola River, very local, and becomes a small tree fifty to sixty feet high and one to two feet in diameter. Its leaves are yellowish, giving the tree the local name of "Yellow Yew;" and on account of its strong, disagreeable odor the name of "Stinking Cedar" is often applied to it, but it is generally called the "False Nutmeg."

49. Torreya Californica, Torrey.

CALIFORNIA FALSE NUTMEG.

[See Illustration No. 29.]

This singular and interesting tree is quite local in two distinct regions, to wit: the Coast Range from Mendocino to the Santa Cruz Mountains, and the western slope of the Sierras from El Dorado to Tulare. The coast locality produces the largest trees, found along the borders of streams, seventy to eighty feet high, and one and one half to three feet in diameter. The wood is light, soft, close grained, susceptible of a fine polish, very durable, and much sought for posts, etc., also for ornamental and cabinet work.

The leaves are bright green, two to three inches long by two to three lines wide, lanceolate, with a sharp apex and a narrowed base, twisted so as to bring the leaves into two ranks. They are also peculiar, in not being keeled by the midrib, either above or below, but the midrib is obscure with a deep, pale colored furrow beneath and on each side of it; also, the leaves are very thin, hardly thicker than writing paper.

Notable trees of False Nutmeg are found near Pescadero two feet or more in diameter, and making a fine rounded head of dark green foliage. The trees bearing the male flowers, in their season, are colored brightly with the large, yellow spikes of flowers. The female trees later are decked off with numerous olive green pendants to the principal branchlets, closely simulating the nutmeg of commerce.

A few small trees of this species are found in the Sierras, notably in that locality which contains so many wonders in almost every department of natural history—Yosemite Valley.

With this species ends the extended descriptions of the matchless Coniferous Forest Development of Northwest America, and the attempt on the part of the writer, to describe all the Cone-bearers within the limits of California; each species for the benefit of comparison, preceded by necessary, but less elaborate descriptions of its relatives, wherever distributed over the earth.

J. G. LEMMON,
Botanist of California State Board of Forestry.

PART III.—GENERAL FORESTAL PAPERS.

FORESTS AND RAINFALL.

By J. G. Lemmon.

There is much conflict of opinion concerning the relations of forest growth to the precipitation of rain or snow; some persons asserting that forests *cause* the precipitation, others that the precipitation is the cause of the forests.

The history of forest denudation in Europe and its results upon climate are set forth in the many volumes of J. C. Browne, also further histories of the treatment of American forests as well, by Prof. Geo. P. Marsh.

In these publications the authors present their opinions, backed by facts, that forests cause precipitation.

Prof. Thomas Meehan, Botanist of the Pennsylvania Board of Agriculture, holds the contrary opinion. In a late periodical he writes: "The ideas emphasized by Marsh in his 'Man and Nature' are now, mainly through our efforts, thoroughly exploded." "It is now conceded," he continues, "that forests are the *result* and not the cause of climatic conditions, though they have a reflex influence on precipitation, which, however, is very small."

"I have shown," he concludes, "that forests have nothing to do with springs or streams except on mountain sides, where they obstruct the flow of surface water and force it to sink down into strata connected with underground rivers."

Certainly this exception contains a large concession to the opposition, and quite substantiates much that is claimed as the cause of the devastating effects of rainfall upon denuded, unsheltered, hard-baked regions, temporarily flooded by torrents. A recent writer, Mr. H. Gannet, the Geographer of the United States Geological Survey, has published a remarkable paper aiming to prove the absence of forest influence upon rainfall. This he attempted to prove by observations noted for several years in certain sections of the country. To this Mr. B. E. Fernow, Chief of the Forestry Division, Department of Agriculture, replied at length during the meetings last winter of the Washington Philosophical Society.

Mr. Fernow examined Mr. Gannet's statistics, and showed that they were faulty, not substantiating his deductions, and that his arguments were at variance with all accepted history of forests, quoting freely from authors in the fourteenth century down to the present, adding that the recorded cases adduced for the bad effect of the destruction of forests upon the plains and valleys would form a large library of themselves.

There are indications that western Asia and northern Africa once possessed extensive forests, and it is well authenticated that southern Europe but recently was densely forested, where now only a few narrow belts remain as private preserves or Government holdings.

No. 27.—Bearing branches from trees near San Bernardino, California. A twiglet with its scale-like leaves, a berry-like cone, and naked seed, enlarged.

The Roman and Spanish peninsulas were once clothed with trees upon their mountain ranges. The capital city of Madrid was founded on a lovely plateau, in the midst of forest trees, and with large sweet water lakes all about it. The Castilians set to work destroying the forests, and paused not while a native tree remained, and Madrid, one of the gayest capitals of Europe, with a population of two hundred and fifty thousand, is surrounded to-day by sterility of the most forbidding character, with not a garden or villa such as usually mark the environs of a great city. The Castilians, after the discovery of the western continent, transplanted their hatred of trees with their colonies to Central America, and founded another capital city on the beautiful and fertile plain of Anahuac, where the populous nations of Montezuma had long lived and spared the trees. The Spaniards soon completely destroyed the trees, "to make the country look like old Spain," and to-day Mexico, occupying the site of the ancient Tescuco, is surrounded by a sun-scorched plain, with scarcely a forest tree in sight—and with them vanished the sparkling lakes and cooling streams.

The descendants of the Pilgrims, though less wasteful, and while utilizing the trees for lumber, have nearly destroyed the most valuable forests in the United States east of the Rocky Mountains.

The great southern Pine belt near the Gulf of Mexico, and the many noble forests of the Pacific Slope remain, save where comparatively small sections have been gleaned of their timber and larger ones denuded by fire. But of late a great change is observable in the sentiments of the people, a healthful agitation of the subject of forestry in all its details, with the dissemination of important information, has resulted in the awakening of the public mind to the dangers arising from the destruction of forests.

Within a few years most of the Northern States, including California, have enacted laws for the preservation of existing forests from wanton destruction, and in some of the States provision is made for renewal or for planting in new situations.

Commissioners of Forestry have been appointed in many of the States charged with the duty of collecting, arranging, and disseminating information in regard to forestry, tree culture, and tree preservation, especially with reference to the necessity of trees for the maintenance of water sources and a salubrious climate, and the prevention of torrents and "cloudbursts."

Powerful advocates of forest preservation have consequently arisen here and there, and appealed to the awakening sense of the community, arguing the feasibility of so cutting out timber and bushes, burning the debris in detail, at favorable seasons of the year, as to both leave sufficient growing trees to preserve the water sources and to keep up the supply of seedlings.

The examples of European nations are cited, nations that were aroused too late to a sense of their wasteful practices, but who are now engaged in renewing and creating forests; and the important facts are pointed out that the foresters of Europe have much more to contend with, in the slowness of the growth of their trees and the cumbersome character of their methods of care and culture, as compared with the extensive machine planting and procuring of more vigorous species of trees on our western prairies. The example of the French in the recla-

mation of the dunes and the Landes is so important and successful as to justify a brief description:

In 1785, or about one hundred years ago, M. Nicholas Bremontier, a French engineer, undertook to plant the long stretch of sand hills that skirt the southwest coast of France (the Bay of Biscay shore) with trees of the Maritime Pine.

These dunes cover a strip of coast between the mouths of the Gironde and the Adour Rivers, one hundred and fifty miles long by three to six miles wide, composed of white sand cast up by the sea, utterly barren, shifting with every gale, and constantly creeping more and more inland.

By various ingenious devices, M. Bremontier succeeded in planting, at first a small section, then the whole strip, with Pines, and soon the forbidding dunes, amounting to one hundred and forty-eight thousand acres, were covered with a fine growth of trees, entirely changing the character of the country, and permitting the establishment of several towns therein, in one of which, *La Teste*, stands a noble monument to the memory of the faithful experimenter.

Reclamation of worthless lands did not stop here. The landlocked region back of the dunes and extending far inland was equally valueless, for opposite reasons, however; floods of water a great part of the year, fatally malarious in summer, and occupied by a poor, ignorant, superstitious class of people, herding their flocks on stilts.

About forty years ago an engineer named Chambrelent examined this forlorn region, called the Landes, and he conceived a plan for its reclamation. Having purchased a large tract, he laid out an extensive system of ditches, carrying the water off into reservoirs as soon as falling; he then sowed upon the drying plains in the spring season, when they could get a start, seeds of the same Maritime Pine, which, to the surprise of the inhabitants, "grew like weeds." This first plantation succeeding so well, Chambrelent had no difficulty in enlisting the aid of the people, and soon similar ditches were draining the entire triangular district of the Landes, in all one million five hundred thousand acres.

To-day a vast forest is found there, railways traverse it, stations and towns have been established where formerly desolation and poisonous gases prevailed; factories are erected, millions of hop poles and telegraph poles are yielded by the thinning out of the plantation, while merchantable square timber and excellent sawed lumber are largely manufactured into useful objects on the spot, or carried to interior towns—and all this from the worthless, malarial, desolate Landes, in less than forty years!

Much was learned, and many facts gathered about forestry in Europe, from the recent visit to California of Herr Kesler, the Chief Forester of Prussia. The Prussian Government plant and care for trees as we do orchards: for the profit there is in them.

They have regular schools of instruction, in which are taught all that pertains to the cultivation, the uses, the preservation of trees. Young men are trained to take care of large areas of lands in forest, selecting the trees to be felled, directing the pruning and thinning, the planting of nurseries and the transplanting to the fields, so that there shall be a constant augmentation of forest values, with proper consumption and no waste.

In such schools Herr Kesler was taught, and, for twenty-one years,

was drilled in the care of stations, being promoted from one position to another, and severely examined in each, until he reached his present high and responsible office, with the direction of the forestry affairs of the entire kingdom.

USEFULNESS OF SNOW DRIFTS.

ECONOMY OF NATURE IN THE STORAGE OF WATER.

By J. G. Lemmon.

A thoughtful article, entitled "Trees and Snow," forwarded to me by R. L. Fulton, of Reno, Nevada, in which he combats several misconceptions concerning the relation of moisture to forest development, as well as agricultural prosperity, tallies so thoroughly with my observations for twenty-three years in the midst of the Sierra Nevada forest, including two winters—or rather two half years at Webber Lake, at an altitude of about six thousand seven hundred feet, that I submit nearly the entire article for publication in this Forestry Report, that it may reach the large number of readers at home and abroad which so able a paper merits.

"TREES AND SNOW.

"It is the general belief that the presence of trees has a tendency to protect the water supply of a country, and that the destruction of forests does much to decrease the flow of streams and to dry up springs.

"There seems to be ample proof that such is the case where the moisture falls in the shape of rain or quickly melting snow; but that it is equally true where it falls in heavy snows, and especially on high mountains, there are many reasons to doubt. That water which drops on shaded ground, thickly spread with spongy leaves, and the air so near the dew point that it cannot absorb much more moisture, should be held back, while that coming down on open ground should run off quickly, seems very natural; but in mountain regions there are peculiar conditions which do much to modify the action of the law.

"The Pine and Fir are the only trees found growing high on the mountains in any abundance, and their thin needles do not make the heavy shade when on the tree, nor the thick mat when on the ground, that the broad leaves of the Maple or the Oak do. Instead of forming a spongy layer three or four inches thick, they are swept away by the wind, and it is not unusual to see the ground bare under the trees in a mountain forest, and all the needles lodged in one or two drifts. Even when they lie where they fall, the coating is comparatively worthless so far as holding moisture is concerned.

"On the other hand, the foliage on this class of trees being as heavy in winter as in summer, the branches catch an immense amount of the falling snow, and hold it up in mid-air for both sun and air to work on, and only those who have had experience of the absorbing power of the dry mountain air can form any idea of the loss from that source. The theory that the shade protects the moisture-laden soil, thus retarding

evaporation, and that each tree, by giving off a constant touch of dampness to the surrounding atmosphere, tends to increase the rainfall, means less when applied to the Sierra Nevada than anywhere else.

"The law is doubtless in force with more or less strength wherever rain falls and plants grow, but the class of trees that thrive in such places require comparatively little moisture, and consequently throw off less than other varieties. They do best on a loose, sandy soil, and are often growing where there is no earth in sight at all, clinging to the sides of cliffs so bare that the roots run along on the surface entirely uncovered until they reach some crevice which they fill, and send tendrils down to drew sustenance from an unseen source. In such places the melting snow disappears quickly from the surface, and except for the influence the trees exert in the way of keeping the ground light and porous, so that the water will soak in instead of running off, it matters but little whether they are there or not. No moisture remains on top of the ground for the shade to protect. It goes either into the air or else into the ground as soon as the snow is melted; and it is a well known fact that a very large portion of the water which finds its way down the steep sides of the Sierra disappears near the sources, and is found again far below, either in springs, by means of artesian wells, or in the increased flow of the parent stream. Indeed, a number of very respectable rivers, not only in the mountains but in some of our valleys, seem to owe their existence to such distant and hidden sources.

"In timber the snowfall is comparatively evenly distributed, and by the radiation and reflection of heat from its own body each particular tree immediately sets itself to work to clear the ground around it, and long before there is a vacant foot out in the open, a space will be bare for several feet around each trunk. So long as there is no color but pure white for the sun's rays to work upon, its heat is largely thrown off; but let a straw or a hair stick through and break the surface, and it will melt the snow or ice for several times its own diameter on every side and stand alone in a few hours. Exactly the same is true on a larger scale of every tree and stump in a forest. Following the reappearance of the sun after every storm, the process begins, slowly or rapidly, according to the temperature, clearing up large patches before that beyond shows signs of a break. It was the observation of these facts more than anything else which led me to believe that Nature has a better and surer way to secure the steady and regular flow of water in the streams than we have been led by popular teaching to believe.

"Another way in which thickly growing timber acts unfavorably, is in the prevention of drifting. The wind will throw up miniature banks in places, it is true, but nothing to what it does where it is left free. Outside the timber belt, where there is nothing to prevent the entire snowfall from reaching the ground, and nothing to break the force of the wind, one of the most powerful and active agents in preserving the water supply of a country comes into play. By forming solid bodies of snow, in the shape of drifts, the most effective means of saving water is reached.

"Across the bleak summits and down the vast cañons of the Sierras the wind has a force well nigh irresistible, and it not only gathers up the snow after it has ceased to come down, but it usually keeps at work all the time it is falling, and carries it, in whirling clouds, until it strikes a cliff or a cañon set at just the right angle, and there the whole

1. California Juniper.
Juniperus Californica.

2.
Var. Utahensis.

No. 28.—Bearing branches from trees in Sierra Valley, Sierra County, California. A twiglet with its scale-like leaves, the berry-like cone, and naked seed, enlarged. The so-called variety is perhaps a distinct species.

load is deposited. As long as there is any material left outside to work upon, this is kept up, and there is no knowing how deep some of the drifts get to be in the course of a long winter. As the days get warmer the surface thaws and moistens a little, but the cold nights, found all the year around at such altitudes, soon transform it into ice, making a crust, upon which the heat of the sun and the absorbing powers of the air find it difficult to make any impression. On open ground the process is aided by the packing power of the wind, and it is not unusual to see a man on horseback traveling comfortably across snowbanks high enough to hide both the horse and his rider many times over, if they broke through.

"It is hardly necessary to point out the advantage of having snow heaped up in large bodies, or buried deep in the cañons, rather than to have it spread out, exposing large surfaces to the sun and the dry air, which in such places is almost constantly in motion. The melting is then almost all done at the bottom, and far into the summer a little rill will be found running away from the lower side. Good sized caves are sometimes formed in this manner, and often the top crust is so solid that the last seen of the big drift will be an arched shell of frozen snow from one bank to the other. The beautiful adaptation of the means to the end, seen everywhere in Nature, is illustrated here. To attempt to hold back an adequate water supply for a great region, like that lying under the Sierra Nevada Range, in any except a solid state would be utterly useless.

"From Roseville, at the western base of the mountains, the summit is reached by crossing just eleven townships of six miles each, making sixty-six miles. Roseville is one hundred and sixty-three feet above the level of the sea, and the summit at the lowest place is over 7,000, and where the straight line touches it, over 9,000. Nothing in a liquid state would tarry long on a hill-side like that. No shade nor mat of leaves would be strong enough to overcome the law of gravitation to that extent. Nothing could detain it but a short time at the furthest, and if it were not for vast drifts which hold the snow until late in the summer, all the horrors prophesied from spring floods and summer droughts would be realized; for I notice that heavy storms continue to visit the places from which the timber has been taken, but when an unfavorable season fails to bank up the snow there is no water in the streams. A strong reason for doubting the orthodox faith is the well known fact that the temperature of the air in a forest is always several degrees higher than it is on open ground under the same conditions otherwise. A series of careful observations were made by Cornell University several years ago, and although the belt of woodland was only half a mile long and sixteen rods wide, the results were very marked. The trees were oak, maple, and chestnut, with some hemlock and pines intermixed, and an abundant undergrowth. The thermometers were changed and one put in another's place frequently, in order to detect possible errors."

The reporter sums up as follows: "A study of the records will show that the temperature of the wooded belt is somewhat higher than that of the open field, amounting from 2 degrees to 4 degrees on the average; that fluctuations are less extreme and less rapid, and that gradual changes in the temperature of the field do not affect that of the belt until a day or two later.

"Five different stations were kept open for several months, one thermometer being placed against the trunk of a large oak near the center of the woods; one near the same tree, but not touching it; a third on a pole four feet from the ground, ten rods from the edge of the woods, and two others in the trunks of trees. A considerable warmer temperature was shown by the instrument suspended from the oak tree, but not touching it, although on several days the one out in the field was exposed to the sunshine, while the others were in the shade all the time. Of course, the higher temperature would have a twofold effect a snowbank. The warmer the air the greater its capacity for holding moisture, and consequently the greater the evaporation, and at the same time the greater its power to melt the snow and start it to running off as water.

"As I have laid considerable stress upon this matter of evaporation, which some may think hardly applies to snow, I will say that a very considerable body of snow has been known to disappear from our streets [Reno, Nev.], without making a particle of mud, leaving the ground dusty, showing that none of it melted, but that it all went directly into the air; and this will occur any time when the thermometer does not go above the melting point (32 degrees) within a short time after a storm. The importance of presenting as small a surface to the action of such an air as that is very apparent, and it is in storing up her snow in heaps and packing it away in deep pockets that the economy of Nature is manifested. The center of the bank will not melt at any time, and it requires a very warm day to get at the underside of a snowdrift. The grass will be growing all around it before the ground gets thawed out sufficiently to start a stream from it; but let a tree stick its head up through the crust, and it will go quickly. I have yet to see the first body of perpetual snow lying among the trees. It will hardly do to say that the only reason is that the timber line lies below such places; for there are many banks of snow which only disappear once in ten years or so, when there comes a long, dry summer, which have trees growing higher up on the same mountain side."

In as large a subject as this there are many peculiar conditions and unknown quantities to discover and consider, but it seems to me that it is worthy of more attention than it has received. My own observations, while they have extended over a period of many years, have been those of a layman and have not been such as to afford mathematical proof, even that a given quantity of snow, say a foot, will last as long on open ground as it will among trees. My belief is that it will last longer, and such is the opinion of those who have had the longest residence in the mountains of California and Nevada, but so far as I am informed no one has made accurate experiments.

In any case I do not wish to be understood as favoring the destruction of the forests of this or any other country. I have never cut a tree down in my life and have never seen one fall without feeling as if I had lost a friend. Whatever is proven, there will always be abundant reasons for preserving extensive tracts of woodland everywhere that trees will grow, and it is time that the matter became one of public concern.

FOREST FIRES.

By J. G. Lemmon.

Whatever may be said about the necessity or wastefulness of the processes of forest consumption by the ax and saw of the lumberman, there is but one opinion concerning the supreme misfortune or criminality of forest destruction by fire.

Property to the amount of $100,000,000 is annually destroyed within the territory of the United States, and it is estimated over $10,000,000 worth of property has been already destroyed in the limits of California during the past season.

Besides the loss of the trees to the State or to individuals, there is usually experienced great inconvenience and misery, owing to the burning of houses, fences, and personal property, to which are often added serious bodily injuries and horrible losses of life that cannot be estimated by money values.

Great as is the damage to present inhabitants when vast forests are swept out of existence in a few hours, or a few days, by devouring flames, yet it is estimated that three times as great damage is done by the fire burning out the mold and other organic elements from the soil.

Always the young seedlings are destroyed utterly, and usually the saplings are killed, if not consumed; while on a section of country from which the whole tree growths have been removed, only fire weeds and brambles will come in until many years after.

How shall the crying evil of forest fires be stopped? Where is the remedy? Who shall apply it?

Legislation is necessary, wisely prepared, judiciously enacted, and thoroughly prosecuted.

"To dispel ignorance should be the first object of legislation," writes Mr. Fernow, of the Agricultural Department at Washington.

If people knew the value of trees, the damage and danger of forest fires; if they once experienced in their own bodies or purses the consequences of carelessness or design in setting fires; if they had the proper conscientious regard for the property, comfort, or safety of others, these wasteful, often woeful, fires would be less frequent.

Then the thoughtless or criminal circumstances that contribute to the firing of the forests; the wholesale slashing of timber, the tree tops and limbs, the cut bushes and other tinder, left by the lumberman or the farmer, ready dried for the escaping campfire, the lighted gun wad, the cigar stump, or the neglected pipe—these contributory conditions must be abated.

The owners of large tracts of timber land which they are denuding, cannot be required to clean up all the tree tops and other tinder traps. This would be absurd, and furthermore unnecessary, but they could be justly required to clean a quarter-mile band around their possessions, and, in case of large holdings, the making of clean traverses through them sufficiently near each other to stop the terrible running fires now so frequent.

We do not make a senseless attack upon the legitimate lumbermaking interest. It is not requisite to do so in order to preserve the forests suffi-

ciently for their own betterment or their moisture-holding conditions. Trees are maturing and decaying everywhere in the dense, primeval forest, and it harms the forest not; in fact, it were better for many considerations if these old ripe trees were removed.

In our northern coast regions, where the rainfall is naturally very abundant and the forests consequently very dense, the complete removal of the trees is not followed by so calamitous a state of affairs as in the sparsely forested southern regions. Once strip the latter and a perpetual desert remains, unless man, with his art, comes to the assistance of Nature, with measures now unknown.

It is a common observation that forests are usually bordered by a fringe of saplings, and these by points and patches of seedlings, all apparently flourishing finely, and promising a material enlargement of the forest area. This is especially noted in nearly level regions where there is no apparent difference in soil between the forested and non-forested areas. Scarce an instance is known where the edge of a forest is dying off, or becoming abridged by the natural course of events.

The question arises: "Is this a normal attribute of forest growth? of forest development? Did they always thus strive to expand, or has some change occurred to them, or their environment, that now enables them to increase their periphery?"

The key to the problem is contained in two words—*Indian fires*. The aborigine desired open prairies and intervales for his game, that the latter might find better forage thereon, and, also, that he might the better mark them for his arrows.

With the retirement of the Indian, and the suspension of the annual forest and prairie fires, the forests everywhere expand; and it is well known that young forests are covering large areas of the eastern United States, and it is believed that the great alluvial plains of the central West, and of the Pacific Slope, might in time be covered with trees, if the practices of modern agriculturists did not serve to prevent their growth, desirable or otherwise.

More than all the destructive practices of the lumberman, the close grazing of the flocks and herds of the stockraiser, is the ruin of the *fire fiend*; and against him the blazing forests, the menaced settlements, and the ruined inhabitants of California appeal to citizens generally, and legislators especially, for instant and adequate protection.

REVISION OF BROKEN-CONE PINES.

By J. G. Lemmon.

Recent explorations and studies have brought out more clearly the real characters of the pair of valuable timber trees which, in the previously issued Forestry Report, I described as the Broken-cone Pines.

The result is a general augmentation of characters, with some important modifications of public descriptions, and one transposition of a misplaced variety.

California Nut-meg.
Torreya Californica.

No. 29.—Bearing branches from Yosemite Valley. One of the nutmeg-like cones is shown cut across, revealing the curious seed.

As these two species constitute the greater part of our western forests, the further discussion of them cannot be without interest.

Most of our impressions of physical objects, their dimensions, relations, qualities, etc., are gained by comparison. This is the touchstone of naturalists.

It was for this reason, and to facilitate a comprehension of our noble trees, that, in the report referred to, the eighteen species of California Pines were first grouped into large classes; then subdivided upon characteristic features into groups, and lastly described in pairs or triplets, that by the simple aid of comparison their characters could be easily detected and retained.

The Broken-cone Pines comprise one of these pairs of species, and they are readily distinguished from the entire-cone group by the fact that their cones at maturity (the second year) break away from the branch by an irregular, transverse fracture within the base of the cone, leaving a few undeveloped basal scales.

No entire cones are ever seen beneath the trees, unless they have been cut off by squirrels or other means before their maturity, which occurs in the Sierras during the months of September and October.

While the cones of other species are occasionally met with that are broken in a similar way, the species alluded to *habitually* behave in this manner, and the designation of "Broken-cone Pines" is therefore sufficiently discriminating.

1. PINUS PONDEROSA, Dougl. "Yellow Pine," "Hard Pine."

The tree that is always called on the Pacific Slope the Yellow Pine is, when fully developed, a tree of the first class, ten to fifteen feet in diameter, and two hundred to two hundred and fifty feet in height.

It may be detected by the color of the bark in mature trees, which is whitish yellow, or sometimes darker, but never black; generally very thick—four to six inches—deeply fissured irregularly into mostly large, longitudinal plates, which, in the whitish yellow trees, is usually soft, flaky, crumbling before the ax into small sinuous lozenges or buttons, and releasing a quantity of yellowish powder from the sutures. The sap-wood, even of small trees, is usually very thin, the annual layers of this tree being soon converted into the condition of dryness and yellowness called heart-wood, at an early age; trees of the largest dimensions often having but one or two inches of live sap-carrying wood, incasing, like a scroll, the mass of darker, lifeless, often resin-filled heart-wood.

The leaves, usually three in a fascicle, are comparatively short—two to four inches—dark green, never glaucous, in young trees remaining persistent for many years, in older ones but a few years, thus giving a tufted appearance to the twigs.

The branchlets of *ponderosa* pines are brownish-green, and shining as if varnished, and, when bruised, they exhale the odor of turpentine; these characters readily distinguishing the trees from the glaucous branchlets with pleasantly aromatic or orange-flower fragrance of the other species—*P. Jeffreyi*—these qualities being especially observable by comparing young trees of the two species.

The infant cones or aments of *ponderosa* are greenish in color, and oval or elongated, one half to one inch long, with pointed, appressed scales. They remain light green or change to olive green until maturity,

when they become a rich brown color, darker within; ovate conical in shape, two to four inches long, the umbo or dorsal protuberance being quadrangular and pyramidal, but slightly elevated and terminated by a small prickle, which is erect or divaricate or but slightly recurved.

Seeds dark brown above, four lines long, wings ten to twelve lines long, widest above the middle, translucent, slightly veined with brown pigment, which the microscope reveals as chains of globules like brilliant rubies.

The male flowers are numerous; long and reddish brown, becoming swollen and flexuous at the time of pollen dispersion.

The Yellow Pine, or *ponderosa*, as thus limited, does not usually comprise the largest number of timber trees in any region and is seldom kept separate in manufacturing, hence statistics of quantities, qualities, values, etc., are impossible.

While the typical *Pinus ponderosa* usually presents the foregoing characters, yet there are forms that differ much from the description given, the principal of which may be designated as follows:

VARIETIES OF PINUS PONDEROSA.

Variety (a) *nigricans*. "Brown-bark Pine, Sappy Pine, etc."—Trees of medium size, one hundred and twenty to one hundred and fifty feet high; flourishing in moister situations than other forms, longer retaining their numerous limbs, hence more symmetrical and spire-shaped or rounded in outline.

Bark dark brown or almost black, hard, comparatively thin, rather coarsely checked, sap-wood of many layers, heart-wood consequently meager, often very resinous.

This form is generally found in company with the larger, typical, whitish-barked trees, but in moister localities. It is particularly prevalent in small valleys and along the edges of forests in the Sierras, notably at Strawberry Valley, near Shasta, and Sierra Valley, Sierra County.

In flowering time during the last days of May, it is conspicuous for its large masses of male flowers, which are reddish brown, flexuous, and long cylindrical, two to four inches in length—the longest of the family.

Female flowers greenish brown, oblong, about an inch in length, with slender, appressed points, becoming the cone, which is apple green until maturity, then leather brown, and three to six inches long, with slender, erect, or divaricate prickles. (Seeds and wings largest of the species.)

This form has been confounded with forms of *Pinus Jeffreyi*, but may always be distinguished by its lighter colored bark, not braided in appearance, its smaller and narrower cones, green until maturity, its leaves apple green, never glaucous, and by its longer, narrower reddish brown male blossoms; also, by its terebinthinous, not aromatic odors.

Variety (b) *Benthamiana* (*P. Benthamiana*, Hartweg). "Foothills Yellow Pine."—A medium sized tree in the coast mountains, and on the western slopes of the Sierra. The young trees usually symmetrical, of spire-like contour, with their apple green foliage, contrasting agreeably with the ashen hue of the Gray-leaf Pine of the same regions, and the olive hue of the Douglas Spruce and White-barked Fir.

Infant cones or aments oblong, nearly an inch in length, on peduncles half as long, drab gray or greenish, with short appressed pointed scales. Maturing cones light green before opening, long and narrow, three to

six inches long, becoming leather brown when opened. Seeds pale, with long—one inch—transparent wings, slightly veined with brown pigment, as described.

Variety (c) *brachyptera*, Engelm. "Southern Yellow Pine."—A medium sized tree, eighty to one hundred and fifty feet high, and in its best estate, on the high plateau of northern Arizona, three to six feet in diameter. Found on the mountains of Arizona and New Mexico, and extending into the northern States of old Mexico. Cones small, ovate, two to four inches long. Seeds small, pale, mottled with brown; wings, one half to an inch long, and nearly transparent.

The great plateau of northern Arizona and New Mexico is overlaid in the center by volcanic scoria—called by the natives *mal pais*—the overflow of the great volcano of Agassiz standing at its northern end, and the scoria is exactly covered throughout its extent—one hundred and fifty by seventy miles—with a noble forest of this pine. Minor forests inhabit the summits of other mountains southward, along with another Broken-cone Pine, the *Pinus Arizonica*, principally distinguished from this by its leaves being constantly in fives, and its branchlets are glaucous, not reddish.

Variety (d) *scopulorum*, Engelm. "Rocky Mountain Yellow Pine."—This is a small spire-shaped tree of the Rocky Mountains, and extending as far east as the Black Hills of Dakota.

Leaves two to three inches long, often in pairs; plume-like at the ends of the branches, owing to their persistence thereon for three or four years before falling. Bark on old trees three to four inches thick; cones ovate, three to four inches long.

This is the principal lumber tree of the Rocky Mountains, and is one of the hardiest of the conifers, occupying arid and exposed sites with southern exposure. Under the conditions stated, if this forest tree should be removed by fire, it could not be expected to recover the ground, as seen in northern, moister localities.

The same remark applies to the forest trees of the southern Sierra and San Bernardino Mountains; once strip them off, and bald mountains must ever remain with deserts about them.

2. PINUS JEFFREYI, Murr. "Black Pine." "Jeffrey's Pine."

The "Black-bark Pine," which by reason of recent examinations is conceived to be clearly distinct, comprises several forms of Broken-cone Pines, chiefly distinguished from the *ponderosa* pines by its affecting more particularly eastern slopes, its darker bark, glaucous branchlets and leaves, with aromatic not turpentine odor, the greater size of its cones with strong, spiny, firmly recurved mucro on the scales, larger seeds with more cotyledons; also, the male flowers mature later and are greenish yellow, shorter and thicker than those of *ponderosa*.

The typical *P. Jeffreyi* in the vicinity of Shasta becomes a large tree, four to six feet in diameter, but not proportionately lofty, being usually rounded in outline, with large, long, often drooping limbs.

The aments or female flowers are purplish, oblong, about an inch long, on stout, erect peduncles of about the same length, the scales of the ament with strong points nearly divaricate, the whole becoming, at maturity, a large cone—the largest of the Broken-cones—six to ten inches long, elliptical in shape, and purplish until maturity the second

season, then changing to leather brown, with wide expanded scales, each armed with spiny, firmly recurved prickles, six to ten inches long, seeds about an inch long, pale with brown veins above, wings narrower than other forms, quarter inch wide, and one to one and a quarter inches long, translucent, slightly veined with brown pigment.

Trees of this description are sparsely met with in many localities of the Sierras, always at high elevations, usually on spurs or outcroppings of granite in an eastern or northern exposure, often as in Eddy Valley, twenty-five miles west of Shasta, composing the principal tree of the region. Characteristic trees of this typical form are met with on the southeastern flanks of Lassen Peak, and Downieville Buttes, southward to the similar exposures near Webber Lake and Lake Tahoe. When accompanied by other pines of the group, they are usually on the highest situations, precisely those crags or slopes which were first left bare by the withdrawal of the ice at the close of the Glacial epoch.

VARIETIES OF PINUS JEFFREYI.

Variety (a) *deflexa* (*P. deflexa*, Torr.). "Red-bark Pine."—This form constitutes the principal timber tree of the higher Sierra, notably near Truckee, and for many miles north and south on the eastward slopes. The trees are of the largest size—one hundred and fifty to three hundred feet high, and under best conditions of development, six to ten feet in diameter, and of the most favorable character for clear lumber, being free from body limbs to a great height. The bark is usually reddish brown, thick, and coarsely checked by wavy lines, especially towards the tops of the trees, giving the bark a braided appearance.

The young trees and branchlets are glaucous, as also are the leaves, and both exhale an aromatic fragrance when bruised, resembling orange or apple.

Infant cones purple, about an inch long on peduncles half as long. Mature cones long, ovate, four to eight inches long, at length broadly ovate by the expansion of the scales. Seeds large, with large, broad wings one to one and a half inches long and half as wide, translucent, and with few brown veins.

Variety (b) *peninsularis*. "Peninsula Pine."—This very marked variety is found only on the San Rafael Mountains, on the peninsula of Lower California, east of Todos Santos Bay, and at an elevation of about four thousand feet. It forms an extensive forest upon loose debris of white granite, seemingly exactly covering the region where this character of rock prevails. Trees of medium to large size—one hundred and fifty to two hundred feet high, with full retained limbs, giving a spire or fusiform appearance. Bark grayish or darker, thick, hard, deeply furrowed, not braided in appearance. Infant cones very large, one to one and a half inches long, elliptical, purple. Mature cones remarkably abundant, covering the ground beneath the trees; broadly ovate, six to eight inches long, distinctly truncate at base, mahogany colored within, scales large, with strong umbo and thick, firmly deflexed prickles.

Variety (c) *ambigua*.—A pine noted by Canby and Sargent, in Flathead Lake Valley, Montana, as being "the prevailing tree of the valley, with purple cones, and long, glaucous foliage." This tree probably belongs with the Jeffreyi group of forms, although Professor Sargent

Pacific Slope Yew.

Taxus brevifolia.

No. 30.—Bearing branches from trees near Grant's Pass, Oregon. The fleshy, cup-like fruit, with its solitary erect seed, displayed. Leaves 2-ranked.

doubtfully referred it to *P. ponderosa* in his report of "Forest Trees of America," in the tenth United States Census, page 193.

The forestal and economical importance of this pair of lumber pines was set forth in the Botanist's Department of the Forestry Report referred to, viz.: 1887 and 1888, pages 93 to 102.

PART IV.—SCHEMES OF DEVELOPMENT AND CLASSIFICATION.

By J. G. Lemmon.

SCHEME I.—General View.

Showing the relations of each group to the others, the characters upon which they are separated, and the position of the Cone-bearers in the vegetable scale.

VEGETABLE KINGDOM.

Plant development is upward and onward along curving lines, dividing and subdividing—the leading lines advanced.

- **Sub-Kingdom I. SPERMOPHYTA.** Flowering, seed-bearing, and conspicuous plants.
  - **Class 1. ANGIOSPERMÆ.** Plants with seeds inclosed in seed vessels.
    - *Sub-Class A.* Dicotyledons. Seeds with two lobes. Growth exogenous.
      - Gamopetalæ { Compositæ.
      - ⟶ Polypetalæ { Leguminosæ, leading all.
      - Apetalæ { Cupuliferæ { Oaks, etc.
    - *Sub-Class B.* Monocotyledons. Seeds undivided. Growth endogenous.
      - Petaloideæ { Lilies, etc.
      - ⟶ Spadicea { Palms, leading their division.
      - Glumaceæ { Grasses, etc.
  - **Class 2. GYMNOSPERMÆ.** Plants with seeds naked and devoid of pistil or stigma. Growth exogenous.
    - Gnetaceæ { Joint-stems, etc.
    - ⟶ Coniferæ { Pines, etc., leading their class.
    - Cycadaceæ { Cycads, etc.
- **Sub-Kingdom II. SPOROPHYTA.** Flowerless, spore-bearing, visible plants.
  - Bryophyta { Mosses.
  - ⟶ Pterodophyta { Ferns, leading their sub-kingdom.
  - Thallophyta { Algæ, etc.
- **Sub-Kingdom III. PROTOPHYTA.** Sexless, microscopic, germ-like plants.
  - *Schyzomycetes* { Bacteria, etc.
  - ⟶ *Saccharomycetes* { Yeast, leading the microgerms.
  - *Palmellaceæ* { Protoccus.
  - *Cyanophyceæ* { Nostoc.

The Protophyta are placed below the Sporophyta in deference to prevailing custom, but if we understood them rightly perhaps we should find them statical conditions of higher plants, and so they might be represented as well above as below the seed-bearing plants.

SCHEME II.

CLASS 2.—GYMNOSPERMÆ.

Trees and Shrubs having pitted wood-cells. Seeds naked, usually in scaly cones. Male and female flowers separated, either on distinct branches (Monœcious), or on separate trees (Diœcious). Pollen distributed by the wind. Leaves mostly persistent, evergreen.

- Order 2. GNETACEÆ. Joint-stems. Arid regions.
  - *Gnetineæ.* Ephedra and allies. Five species on Pacific Slope. Two species in California.
  - *Welwitchineæ.* A solitary African genus of a species.
- → Order 1. CONIFERÆ. Cone-bearers. Widely distributed.
  - *Cupressaceæ.* Cypress and allies. Three tribes.
  - → *Pinaceæ.* Pines and allies. Three tribes.
  - *Taxaceæ.* Yews and allies. Four tribes.
- CYCADACEÆ. Palm-like plants. Tropical regions.
  - *Zamiæ.* Zamia and allies. Rarely cultivated.
  - *Cycadeæ.* Cycads and allies. Common in cultivation.

SCHEME III.

ORDER 1.

CONIFERÆ.—THE CONE-BEARERS.

Widely distributed, resinous, and mostly evergreen trees and shrubs of cool regions; fruit mostly cone-shaped and scaly; leaves mostly needle-shaped; male flowers spike-like, of many stamens.

- Sub-Order 2. CUPRESSACEÆ. Cypresses and their allies.
  - *Cupressineæ.* Cypress tribe.
  - → *Taxodineæ.* Redwood tribe.
  - *Juniperineæ.* Juniper tribe.
- → Sub-Order 1. PINACEÆ. Pines and their nearest allies.
  - *Araucarieæ.* Southern pitch trees.
  - → *Abietineæ.*
  - Cl
- Sub-Order 3. TAXACEÆ.
  - *Taxineæ.* True Yews.
  - → *Podocarpeæ.* Foot-stalked Yews.
  - *Dacrydeæ.* Tear-gum Yews.
  - *Saxe Gotheæ.* Prince of Wales Yew.

SCHEME IV.

SUB-ORDER 1.

PINACEÆ.—PINES AND THEIR ALLIES.

Comprise the greater part of the resin-producing trees. Fruit, conical or globose, of woody or leathery scales spirally arranged, and imbricated on an elongated axis; ovules one to seven under each scale, inverted.

- Tribe II. ARAUCARIEÆ. Austral pitch trees. Cone-scales one-seeded.
  - *Dammara.* Wax Pines.
    - *Alternans.*
    - *Decussans.*
  - *Araucarieæ.* Araucaria.
    - *Eutacta.*
    - *Columbea.*
- → Tribe I. ABIETINEÆ. True pitch trees. Cone-scales two-seeded.
  - *Fasciculares.* Secondary leaves fascicled.
    - *Cedrus.* { Cedar.
    - → *Pinus.* { Pine.
    - *Larix.* { Larch.
  - *Solitares.* No secondary leaves.
    - "*Penderes.*" { Spruce.
    - *Abies.* { Fir.
- Tribe III. CUNNINGHAMIÆ. Oriental trees. Cone-scales one seventh-seeded.
  - *Arthrotaxis.* { Joint-stem Yew.
  - → *Sciadopytis.* { Parasol Pine.
  - *Cunninghamia.* { Chinese Pine.

SCHEME V.

TRIBE I.

ABIETINEÆ.—TRUE PITCH TREES.

Very resinous trees, confined to cool northern regions. Fruit, a woody or leathery cone or burr of spirally overlapping scales on an elongated axis, each scale bearing two inverted ovules, becoming usually winged seeds.

- **Sub-Tribe 1.** FASCICULARES. Secondary leaves fascicled.
  - *Cedrus.* True Cedar. Fruit erect.
    - *Decidua.* Scales deciduous; one species, "Tree of God," Himalaya Mountains.
    - *Persistans.* Scales persistent; two species, one in Algeria, one on Mount Lebanon.
  - → *Pinus.* True Pine. Fruit diverse.
    - *Pinaster.* Fruit armed; sixty two species, fourteen in California.
    - *Strobus.* Fruit smooth; fifteen species, four in California.
  - *Larix.* Larch. Leaves deciduous.
    - *Pseudo-larix.* Fruit pendent; scales deciduous; one species in China.
    - *Eu-larix.* Fruit erect; scales persistent; eight species, two on Pacific Slope.
- **Sub-Tribe 2.** SOLITARES. All the leaves scattered.
  - "*Penderes.*" Spruce. Fruit dependent; scales persistent.
    - *Tsuga* and *Hesperopeuce.* Seeds resinous; branchlets rough; leaves petioled; six species, two in California.
    - → *Picea.* Branchlets rough; leaves sessile, keeled; eight species, two in California.
    - *Pseudo-tsuga.* Cone-bracts exserted; leaves petioled, flat; two species on Pacific Slope.
  - *Abies.* True Fir. Fruit erect; scales deciduous.
    - *Megacarpæ.* Cones large, bark red within; five species, four on Pacific Slope, one in California.
    - *Microcarpæ.* Cones smaller, bark grayish within; twenty species, five on Pacific Slope, four in California.

SCHEME VI.

SUB-ORDER 2. CUPRESSACEÆ.—CYPRESSES AND THEIR ALLIES. Slightly resinous trees, found in cool northern regions. Fruit berry-like, or a woody cone, of ob-pyramidal or valvate scales; ovules erect, two to seven under each scale, mostly wingless.	TRIBE II. CUPRESSINEÆ. (American genera only.) Scales verticillate or opposite.	*Arbor Vitæ.* Fruit elongated. Scales valvate.	*Thuya.*	American Cedar. Six known species, one in California.
			Libocedrus.	Incense Cedar. Four known species, one in California.
		Cupressi Fruit globose. Scales peltate.	*Chamæcyparis.*	Ground Cedar. Twelve known species, two in California.
			Cupressus.	True Cypress. Seventeen known species, three in California.
	TRIBE I. TAXODINEÆ. Fruit-scales spiral and peltate.	TAXODIEÆ. Fruit axis elongated.	*Sequoia.*	Redwood, Big Tree. Two species, and only in California.
			Taxodium.	Bald Cypress. Three species, one in eastern United States.
		GLYPTOSTROBI. Fruit axis depressed.	*Glyptostrobi* -	Embossed Cypress. One species, China, much cul-
			Cryptomeria.	species, Japan, much culti-
	TRIBE III. JUNIPERINEÆ. Fruit berry-like.	*Juniperus vera.* Leaves ternate and pungent.	*Oxycedrus.*	Sharp-leaved Junipers. Ten species, two in California.
			Cupressoides.	Cypress-like Junipers. Twelve species, none in California.
		Sabina. Leaves opposite and scale-like.		Savin Juniper. Eleven known species, two or three in California.

APPENDIX TO BOTANIST'S REPORT.

Correspondence relating to certain mooted questions concerning our *Sequoias*. [Discussed in the report, pages 157–168, inclusive.]

CIRCULAR LETTER OF INQUIRY.

The following letter was addressed to the principal dendrologists of the East and Europe:

LEMMON HERBARIUM, CALIFORNIA HALL,
105 CLAY STREET, OAKLAND, CAL., June 1, 1890.

Professor ——:

MY DEAR SIR: In the Second Biennial Report of the California State Board of Forestry for 1887 and 1888, I had the honor to classify and describe in a familiar, popular way the genus *Pinus*, of which you know we have a large number of species on the northwest coast of America.

I am now elaborating the rest of the tribe *Abietineæ* for the forthcoming report due in August next, and perhaps will also reach the *Cupressaceæ* this season. At all events I shall soon have to grapple with the troublesome genus of *Sequoia*, and I need all the light that has been recently shed upon the subject, hence I apply to you, my dear sir, for information.

First, in regard to the origin of the name *Sequoia*. It is current among us Americans that Professor Endlicher so named our Redwood in honor of Sequoyah, a half-breed Cherokee, who had invented an alphabet for his tribe; but as long ago as 1878 Dr. Gray assured me that such a reference was an after-thought; that Endlicher certainly meant by *Sequoia* that our giant tree was a sequence, a follower, as it truly is the rear guard of a past procession of prodigious species.

Now, what is the fact in the case? Did Endlicher leave any statement of his reason for coining the word *Sequoia?*

Another question. I contemplate adopting Dr. Lindley's view [opinion reversed since] regarding the distinctiveness of *Wellingtonia*, notwithstanding the almost identical character of the fruit. The vegetative character separating our two species are certainly most marked, in the one case resembling those of Cypress, in the other those of the Yew.

If systematists without a qualm consent to separate *Chamæcyparis* from *Cupressus*, and *Tsuga* from *Picea*, I cannot see why, reasonably, they can hesitate to give *Wellingtonia* generic rank.

All paleontological research strengthens this opinion, it appears, for the vestiges of a score or more of fossil *Taxodiæ* fall decidedly into two classes of cypress-like and taxus-like characters, indicating two marked lines of development, of which our two giants are undoubtedly descendants; so why not recognize separate generic types, as in other closely allied cases?

Please favor me with your views upon these important questions, and I shall be always

Your greatly obliged servant,

J. G. LEMMON.

REPLIES.

Reply of Prof. Thomas Meehan, Botanist of the Board of Agriculture of the Commonwealth of Pennsylvania:

GERMANTOWN, PA., July 8, 1890.

MY DEAR PROFESSOR LEMMON: I love a new thought, and enjoyed your chat on Wellingtonia in "Gardener's Chronicle," p. 798. But are you *sure* Dr. Gray said *that* about Sequoia? From the time I started the "Gardener's Monthly" till his death, Dr. Gray had a habit of sending me a friendly criticism whenever anything occurred that did not meet his full approval. In an early number of my periodical was a full account of the origin of the name as "currently" received, by a very learned and careful critic long since deceased, J. H. Lippincott, who was personally acquainted with De Candolle, and possibly with some of the immediate associates of Endlicher. I think his opportunities for judging would be equal to any one's, and you will see by the article he regarded it no myth. But, and this is what I want to say, I am sure if Dr. Gray, *at that time*, regarded the story as but an after-thought, he would have so said to me. If you have not

misunderstood him in 1878, it would only show that fifteen or sixteen years after that article appeared Dr. Gray had changed his mind. For myself I should regard the "sequence" origin as still more unlikely, for, in what way could Endlicher construct orthographically *Sequoia* out of either the Greek or Latin root of *sequence?* Endlicher did not leave any *written* statement for his name, but it is understood that he so stated verbally to his friends as "reported."

As for *Wellingtonia*, while your points are well taken, it would scarcely then be the Wellingtonia of *Lindley*. I think Veitch shows clearly that Lindley's reasons are untenable.

After all, who can set bounds to any of the genera of coniferæ? I have often been struck by the resemblance of the seeds of *Sequoia gigantea* to those of *Cryptomeria Japonica*. When mixed who could separate them? If we went by such characters alone, the big fellow might be Cryptomeria. Even the cone, if it were not quite too rough, has no great unlikeness. I am not following changes in coniferal nomenclature with much ardor.

Very sincerely,

THOMAS MEEHAN.

Reply from Prof. E. B. Southwick, Secretary of New York Forestry Association:

NEW YORK, January 23, 1890.

Professor LEMMON, *Botanist California State Forestry Association:*

DEAR SIR: I received your very valuable report some time ago, and have waited until I might read it before sending my "thanks." I now do so, with the assurance that it is one of the ablest and best reports extant; and the way you have handled the Pines is truly wonderful. I fear some of our "big guns" will be put in the shade somewhat, and I am glad of it. I have not only read your work *three* times, but have copied all your classifications, etc., so I might better become acquainted with it. In fact, the matter has been so valuable to me that I want to thank you personally for your labors. I wish you could come here some time and enthuse us. I would like to get cones and fruits of your trees. Could you exchange, or sell? I have a large collection of our own forestry specimens. May I hope to hear from you some time?

Sincerely yours,

E. B. SOUTHWICK.

Reply from Dr. Maxwell T. Masters, editor of "The Gardener's Chronicle:"

41 WELLINGTON STREET, STRAND, W. C., LONDON, May 4, 1890.

MY DEAR SIR: I have received your report on California forests, etc., with great pleasure, as its contents are specially interesting to me just now, when I have been working at the morphology and life history of the conifers. It so happens, also, that many of the species introduced to this country by Douglas, Jeffrey, and other later collectors, are now getting into the cone-bearing stage here, so that I have had an opportunity of studying them. I enjoyed the benefit and pleasure of Engelmann's correspondence on the subject, as I still do that of Sargent, and if my results are not always the same as those of those great authorities, the reason is not *wholly* on account of my lack of knowledge as compared with theirs, but is also to be attributed to the different circumstances and conditions under which the trees grow here. Your report, and its *illustrative photographs*, will be of great service to me. I sent you a few days since one of my miscellaneous papers on conifers, the illustrations in which were taken from the "Gardener's Chronicle." If, during the summer, I have occasion to figure any more of the Californian or Oregon species, I will do myself the pleasure of sending you a copy.

With many thanks, faithfully yours,

MAXWELL T. MASTERS.

To J. G. LEMMON, Esq.

Reply from the venerable French botanist, Prof. Alphonse De Candolle, principal editor of the "Prodromus." Translated from the French:

GENEVA, SWITZERLAND, June 22, 1890.

MY DEAR SIR: I thank you for your Bulletin No. 7, which you so kindly sent me. The conservation of the forests in California is very important, because the country has dry seasons, which would hinder the reproduction of trees, as was formerly the case in Greece, Syria, Italy, etc.

The supposed origin of the word Sequoia is entirely fanciful, having no basis. Endlicher seems never to have said why he had taken this name. See Synopsis Coniferæum, Geneva supplement to Gordon's Pinetum, 1858, p. 303, he says: "Name not explained." Koch in Dendrologi, 1872, Vol. 2, Part II, p. 173, says: "It has its origin in California." He gives no proof of the assertion, but by the appearance of the name it seems to be

very probable that the name originated or was taken up by the natives, and perhaps written more or less correctly.

After all, it matters little, *a name is a name*. The essential thing is, first, that it be the expression of a natural genus; second, that it had not been employed before; and, third, that the genus had not previously received another name.

As to the question, to admit or not admit another species of Conifera, will you please allow me to be excused from an opinion, as I have not made a special study of that family.

Receive, please, my dear sir, the assurances of my cordial regards.

ALPHONSE DE CANDOLLE.

Reply from Sir Joseph D. Hooker, late Director Royal Gardens, Kew, England, and President of the Royal Society:

THE CAMP, SUNNINGDALE, July 28, 1890.

DEAR MR. LEMMON: I have been looking in vain for anything that would throw light upon the subject of your queries.

My impression is very strong that Gray accepted the view of Sequoia being named in honor of the American who invented the alphabet of his tribe language. But I have sought in vain for any printed confirmation of this. I have not, however, looked through all his writings about the Big Trees.

I cannot go with you at all in separating, generically, *S. gigantea* from *S. sempervirens*; even if the distinction you make (the disposition of the leaves) held good, *which it does not*, it would not suffice to found a genus upon.

Not only has *Sequoia sempervirens* some states in which the leaves are imbricate, as in *S. gigantea*, but other genera, as *Podocarpus*, and I think the *Dacrydium*, have them with bifarious and imbricate leaves on the same tree, and even on the same branch.

Very sincerely,

J. D. HOOKER.

INDEX TO BOTANIST'S REPORT.

ERRATUM.

Page 46, line 26 from top, for "Arundinaria macrosperma" read "Arundo donax."

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